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Future Developments in Occupational Psychology

By L. S. HEARNSHAW

This is the text of an address given at the 1953 Annual Conference of the National Institute of Industrial Psychology, held at Buxton. The author is Professor of Psychology in the University of Liverpool.

REASONS FOR FAITH

IT is perhaps of some assistance in the very difficult task of looking into the future to cast our mind back into the past. At the beginning of the present century few persons had the vision to foresee the tremendous development of motor transport which the coming half-century held in store. When in 1900 the 1,000-mile car trial round Great Britain was organised it was designed partly to counter the ridicule and dislike of the public for this new, noisy and as yet unreliable contraption. But in spite of public opposition the pioneers themselves had faith in their invention. They felt that the harnessing of mechanical force to transport was in principle right, that science and technology were behind their enterprise, and that in the long run it was bound to succeed. In this faith they proved abundantly right.

My faith in the future of occupational psychology is rather similar. The application to the human problems of occupational life of the growing human sciences has the same kind of motivation. Occupational psychology is fed from a vital and developing science of psychology, from an increasing body of fundamental research which is already large in quantity and in some areas beginning to reach maturity. The rapid progress of psychological concepts and techniques in the last twenty years is a most significant phenomenon, of which perhaps only the readers of technical journals and reports are fully aware. It is against this progress that the future of occupational psychology must be envisaged. No technology can develop far unless it be rooted in fundamental science. Occupational psychology is rooted in the fundamental science of psychology, and derives its impetus from the growing power of psychological research.

Since the war there has been a widespread interest in all industrial countries in the human problems of industry. In a recent survey of the reading habits of business executives in America the area of personnel management provided the most frequent reading matter, while economics was a mere second. Personnel management, human relations, industrial welfare, human engineering, ergonomics—the field seems to be a crowded one, and some may doubt whether occupational psychology has any distinctive contribution to make. I believe it has, partly because it is more firmly rooted in fundamental principles than any other approach, and partly because like all branches of science occupational psychology is not a dogmatic but an evolving subject. It is self-correcting, in the sense that it demands the verification of its hypotheses and the validation of its procedures. It is not propounding a creed by the fate of which it stands or falls, but seeking for truth undogmatically. Its only article of faith is its adherence to scientific method and the techniques of verification and validation to which every theory and procedure must be subjected. It inherits from the scientific view point that unique combination of breadth of vision and precision of detail which has given science its extraordinary scope and power.

The average business man still regards psychology as something fanciful and impractical. Majorities, however, are generally wrong when it comes to passing judgment on new ideas and new movements, as they were half a century ago in the matter of the motor-car. Unfortunately the issue is blurred in the case of psychology by the large amount of worthless popular psychology which continues to flood the market. But for those with eyes to see there is a developing scientific psychology. Because occupational psychology is a branch of this movement it is the most fundamental of all the approaches to the human problems of industry. Occupational psychology as such rather than any watered-down 'human relations' holds out the best hope for progress in the future. In the long run the psychologist trained to use scientific method and increasingly refined techniques and equipped to find his way among the growing body of ascertained fact, is likely to play an ever more and more important role in industry.

To attempt to predict the lines along which occupational psychology is likely to develop is a more precarious undertaking than to predict in general terms that it has a future. Probably in this country the relative shortage of funds for research, and the fact that a considerable proportion of the available funds comes from government sources will ensure that the development of occupational psychology will be fairly closely tied to practical requirements and centre round urgent practical problems. I select three major areas for discussion, without in any way suggesting that the list is exhaustive. I deal too with problems rather than with answers, for it would be presumptuous to try to forecast these.

THE UTILISATION OF MAN-POWER

Compared with many other countries of the world this country is relatively ill endowed with natural resources. The skills and character of our people are the most important of the resources upon which our economic well-being depends. The wise utilisation of our man-power is, therefore, for us, more than for most other nations, a matter of vital concern. Our population is now static, and in the immediate future it is certain that the proportion of elderly persons in the population will increase. There is a strictly limited pool of persons with high ability to fill technical, professional and managerial jobs. In a recent conference between the Federation of British Industries and the Vice-Chancellors of our Universities, Dr Eric Ashby, Vice-Chancellor of the University of Belfast, pointed out that in 1952 18-year-olds in the top intelligence group numbered 15,000 compared with 19,000 in 1912. The annual intake into the universities was only 4,000 in 1912 compared with 16,500 in 1952. During that period the civil service had expanded, the armed services grown vastly, and scientific research come of age—all making heavy demands on the high ability group. High intelligence has become a scarce commodity, and it has become extraordinarily important that the aptitudes of the abler sections of the population should not be wasted. This involves three things: ascertainment, education, and attraction, in all of which psychology has a part to play.

If there is any truth at all in the hypothesis that ability is in part dependent on genetic endowment, it seems that methods of ascertainment capable of assessing potential levels of ability before they have been developed by experience are going to remain important. Existing tests may be of somewhat limited value, but this does not mean that more adequate instruments will not be devised as the result of future research. The signs seem to me to be not unpromising, and I see no reason why we should not see new tests which might prove of great value in occupational selection. For instance, work now in progress on the higher levels of intelligence should lead to the construction of tests assessing aspects of intelligence not measured by existing tests. Guilford in America is carrying out important research on creativity. Thurstone, too, is experimenting with some entirely new objective tests for temperament. And it is not impossible that quite new methods such as the measurement of brain rhythms by the electroencephalograph might turn out to have a role to play in assessing aptitudes. Perhaps equally necessary is the critical evaluation of older methods of assessment, such as the interview, which the application of psychological techniques makes possible.

I do not propose to say anything about the vast subject of industrial education and training, about which nearly every productivity team returning from America has had some observations to make. But I must say something about the rather neglected third topic, the attraction of persons of high ability into industry and other productive careers. As civilisation becomes more complex the strain of living becomes greater, and values often become confused. The tendency to retreat from the turmoil and to find refuge in the realm of the ideal or in some sheltered backwater, exercises a powerful attraction on an increasing number of persons, including some of the ablest. This does not necessarily mean monastic seclusion (though the post-war increase in monastic intake both in Europe and America is probably not without significance); it may merely imply that a proportion of persons prefers jobs involving a low degree of stress, and responsibilities much below their capacity to carry. The moral rights and wrongs of this attitude are open to discussion; it is clear, however, that i any considerable number of persons were to choose such a course the kind of technical society in which we live must become increasingly difficult to sustain. The totalitarian method is to compel. This method is repugnant to the traditions of our own society, and in the long run dubiously efficacious. But if we are not to have recourse to compulsion it becomes all the more necessary to study the reasons why persons are attracted into positions of responsibility, and the sources of the frustration and disillusionment which promote withdrawal. This problem is particularly important to industry. There is still prejudice in this country against careers in industry though it is less strong than it was 25 years ago. Where are these attitudes acquired? How and why are they transmitted? What changes need to be made in industry to render it more attractive to persons of high ability? It is not, I am sure, for many persons mainly a matter of money, but something bound up with their freedom of mind and independence. I believe that this question is going to become one of some importance for industry, and that it is a question in the study of which psychology is implicated.

On a more directly practical plane there is much that is unsatisfactory and wasteful in the vocational placement of the ordinary school leaver. Recent investigations such as that of Jahoda (1952) have shown a good deal of haphazard job placement. We have been slow in this country to make use of the improved methods of assessment which research has developed and tested, and which war-time saw widely employed in the services. Our methods of vocational guidance are considerably less thorough than those already in routine operation in some other countries. An admirable first step would be the implementation of the suggestion made by Alec Rodger that research officers should be attached to the Youth Employment Service to assess existing methods and to ascertain ways of introducing better methods. The maladjustments resulting from the misplacement and the mishandling of the juvenile in industry are so lasting and so serious in their effects that it is difficult not to believe that we shall be compelled to take up this matter more thoroughly in the future. And indeed there are already more than a few signs that the problem is to receive increasing attention.

It is safe to predict, I think, that there will be an increasing use of occupational psychology in connection with man-power problems. The occupational psychologist may not have all the answers, but he does seem to be developing the techniques which may help to provide the answers.

THE WILL TO WORK

Another key question in the kind of age into which we are moving is the whole matter of incentives. In his broadcast talks on 'The New Society' in May, 1951, E. H. Carr said, " the attitude of the new society to work is perhaps the most crucial issue which it yet has to face, since the fate of every society depends in the long run on the productivity of its workers ". Without constant vigilance there can be little doubt that standards, both quantitative and qualitative, can slip disastrously, and public opinion can gradually become resigned to the very third-rate. As Carr pointed out in his broadcasts, the old and very powerful incentive of fear has been enormously watered down, but so far no very effective substitute has been found. This is certainly an issue that will have to be faced, and it is an issue on which the occupational psychologist should have something to say, for perhaps the chief danger in this field is that of narrow views and the tendency to aim at quick, short-term results without regard to ultimate consequences.

There has already been a shift of emphasis among psychologists from incentive schemes and what Adam Curle has termed 'psychological makeshifts'. The reason for this is that incentive schemes do not work automatically, but only in certain kinds of context or as ingredients in a larger pattern. A study by Roy (1952) in an American machine shop, for instance, indicated that the operators were restricting output by wasting 2½ to 3 hours in an 8 hour day in spite of a piece-rate pay plan. Many cases have been reported in which overheads consequent upon incentive payment plans have more than counter-balanced gains and led to higher eventual costs to management. However, there is equally no doubt that in appropriate contexts incentive schemes have led to very remarkable results. Perhaps the most outstanding example is the Lincoln Electric Company's incentive scheme described in Lincoln's book *Incentive Management*. This scheme has led to very high efficiency together with the payment of perhaps the highest industrial wages in the world. But as a perusal of the book will show, it is very much more than a mere incentive scheme. Incentives are an element in a much wider plan involving a whole philosophy of management, and a social restructuring of the works. This remarkable experiment has grown slowly over some 40 years, and it is probable that a gradual growth in time is a factor which we must always keep in mind in dealing with human relations in industry. It is one of the dangers of the methods engineering approach to human problems, as contrasted with the more biological outlook of the psychologist, that it tends to demand results too quickly and ignores the need for slow growth processes.

Psychological research, therefore, is shifting from the examination of incentive schemes as such towards social studies of high productivity units with a view to disengaging the factors that make for high productivity. This trend is exemplified by the work of Marriott in this country, and by the Michigan investigations in the United States. The Michigan studies have already thrown some doubt on the traditional principles of industrial administration. High productivity groups were marked by loose, informal and more personal structures rather than by precisely elaborated hierarchies and detailed job specifications. As Whyte (1951) stated in another context, "the alleged principles of administration are a curious mixture of folk-lore and fact". Here again perhaps the most important fact is that traditional viewpoints are being called in question as the result of the more scientific approach of the occupational psychologist.

A so far rather neglected, but nevertheless central, factor in the will to work is the factor of obligation. It seems probable that occupational psychologists will be forced to pay more attention to obligation in the future. When we analyse the meaning of work, and ask what distinguishes it from other activities, we arrive in the end at the conclusion that work involves a system of mutual obligations. It is more than a matter of 'want', but a matter of 'must'. Incentives can support and reinforce obligation, they cannot replace it. As Ernest Bevin remarked, "you cannot have social security in this country without having some obligation". In his broadcasts already referred to, Carr pointed out that "no period before the 19th century would have questioned the existence of a right to compel men to work". Obligations seem to imply some sort of sanctions. But this side of the matter has its dangers, and psychologically the most important question is how the sense of obligation becomes part of a man's character, what conditions are favourable for its growth, and what conditions unfavourable. These are not short-term problems, but they are very fundamental ones, and the occupational psychologist will sooner or later have to face them. The work of social psychologists on roles, norms, attitudes and the process of socialisation has usefully paved the way.

INDUSTRIAL PATHOLOGY

The third topic which it seems to me is likely to be important in the future development of occupational psychology is what might be termed industrial pathology. There is a growing realisation that in a good deal of industrial behaviour, both individual and group, we are confronted with behaviour that cannot be understood in rational terms, in other words behaviour which is in fact psychopathological. This is not a new point of view. It was perhaps first clearly expressed by an American economist, C. H. Parker, in a striking series of essays published in 1920 under the title *The Casual Laborer and Other Essays*. And it was also, of course, the point of view of Elton Mayo in his account of obsessive thinking among industrial workers. Renewed and more intensive work on the problems of industrial pathology and its various symptoms (strikes, high labour turnover, absenteeism, industrial neurosis, rigidity of attitudes) is desirable mainly because in our present weakened economic condition this disease might well prove mortal. What would be the effect on our national economy today of a major coal strike like that of 1926? If the behaviour sciences can throw any light on the causes of this pathology, and if they have any suggestions to make as to possible therapeutic measures it is of the utmost importance that they should be utilised. We need have no illusions either about the great complexity of the factors involved or about the many obstacles which therapeutic measures are likely to meet with in practice. Nevertheless it still seems worth while to prosecute research as vigorously as possible and to gain as much insight as possible into the nature of these pathological phenomena which seem to accompany modern industry wherever it becomes established. It may enable us in the long run to build a more wholesome industrial structure, and in the short run to avoid some of the tensions and upheavals which have caused so much wastage in the past, and which we can ill afford in the future. In this field as in the other two which have been referred to the concepts and the techniques developed by the psychologist seem absolutely necessary if progress in understanding is to take place.

PRACTICAL PROBLEMS

The future development of occupational psychology depends on a close relation between the psychologist and industry. For this to take place the psychologist must have a better understanding of industry and the industrialist a better understanding of psychology. In the first place it is a matter of better training on both sides. There has been a good deal of discussion about the training of the occupational psychologist, but so far little implementation. I do not believe that an occupational psychologist can be trained wholly in the laboratory, and there seem to me to be considerable dangers in the present tendency of appointing to industrial research units psychologists with no field experience. I agree with those who hold that postgraduate training in occupational psychology is necessary to supplement the basic training in psychology, and that this postgraduate training must include experience in industry itself. An essential practical problem in connection with this postgraduate training is the provision of adequate grants for postgraduate students, and it is to be hoped that sooner or later industry will make funds available for the endowment of postgraduate scholarships.

The training of future managers and trade-union officials in psychology is equally important. While it is quite clear that time would not allow more than an introductory training in occupational psychology, this training should not be a well-meaning and watered-down 'human relations programme', but should include some comprehension of the key concepts and methods of modern psychology. There must be more understanding of the need for getting down to first principles and more awareness of the importance of scientific methods of analysis and verification than is usually given in short courses on the human problems of industry. It would be a good thing, too, in my opinion, if some industrial managers and some trade-union officials were fully trained psychologists, so that the psychological point of view could be adequately presented at managerial and trade-union meetings and conferences. There are many trained engineers and trained accountants in managerial positions who can voice the technical and the financial points of view, but so far very few trained psychologists in managerial positions.

Finally, there is a need for the close day-to-day contact between the psychologist and industry which can come about only if some psychologists are working in and for industrial organisations. Few firms at present employ their own occupational psychologists. Perhaps before long it will be regarded as essential for a large firm with a progressive personnel policy to have its own occupational psychologist. But before that happens on any considerable scale it will be necessary for proper training courses to have been established, and for firms to have a reasonable assurance that the persons they employ in this capacity are fully competent. The example of France, where occupational psychologists are awarded a state diploma after having received a thorough theoretical and practical training, is worthy of careful attention. Provided there are sufficient trained occupational psychologists to meet the demand, and provided there are a sufficient number of enlightened managers to realise the opportunities, the stage is set for the progressive development of occupational psychology. It is now some thirty-five years since the first tentative investigations were carried out in this country. Enough experience has been gained to justify a decisive expansion in the near future. It is perhaps significant that the latest giant American trust to be established, the Ford Foundation, is to devote its large resources to the development and application of the human sciences. For those that have the vision to see this is the realm that holds open the most important prospects of fruitful advance for humanity, not only in material well-being, although this might well be considerable, but in terms of human happiness.

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Four Years Later: A Follow-up of an Experiment in Selecting Supervisors

By JOHN D. HANDYSIDE and DAVID C. DUNCAN

The original experimental selection procedure was operated by members of the management of the firm with the advice and assistance of Brigadier F. I. de la P. Garforth, representing the National Institute of Industrial Psychology. The analysis of the data and the preparation of this paper were the work of Mr Handyside and Mr Duncan, who are members of the Institute's Foremanship Research Group.

In June, 1948, the Institute's Foremanship Research Group conducted an experimental selection procedure in a large heavy engineering works in Scotland. Two different selections for promotion to supervisory positions were made from a field of 110 candidates, obtained by advertisement within the firm. The first selection was made by management by their customary method of review and nomination; in the second, from the same field, systematic methods were used, including biographical history sheets, recommendation forms, intelligence tests, interviews, group discussion sessions, and a final selection panel. This latter procedure was run by members of the management with the advice and assistance of a member of the Institute's staff. The procedure and results of a follow-up carried out two years after the original selections were made are described in earlier publications (NIIP, 1951; Castle and Garforth, 1951).

All that need be said here is that the final gradings by the selection panel, taking the whole of the experimental procedure into consideration, for the 44 men regarded as worth serious consideration for promotion, correlated .68 ± .08 with assessments made on these men by their managers two years after the original selection. This was an encouraging result, not so much because of the absolute size of the prediction coefficient, but in comparison with the poor prediction, .23 ± .14, obtained by management's normal procedure.

The remainder of this paper will discuss the results of a follow-up carried out in November, 1952, *i.e.*, 4 years 5 months after the original selection experiment.

THE CRITERIA

Two criteria were available against which to assess the efficiency of selection: first, ratings by managers who were in a position to assess the performance of the men concerned; and, secondly, whether the men had been promoted twice, once, or not at all during the four and a half year period.

It was possible to obtain ratings on 34 men at the time of the second follow-up. None of the remaining ten men had been promoted since the first follow-up, and it was, therefore, considered acceptable to take the first follow-up gradings of these men as reasonable estimates of the grades they would have obtained on the second follow-up, for although the correlation between 1st and 2nd follow-up grades for the 34 cases was only .60, the ten men on whom no second follow-up data were gathered were selected from the lower grades, having obtained 4 C's, 5 D's and 1 E on the first follow-up, a six point scale from AA to E being used for grading. (If these ten men are graded the same on the second as on the first follow-up, the correlation for the 44 men rises to .79 in comparison with .71 which is the figure obtained by correcting the correlation for the 34 cases for selectivity.)

The apparently objective criterion of the incidence of promotion has considerable limitations. Some men who are highly regarded by their managers have not yet attained a second promotion because of circumstances which have no relation to their capacity to fill senior posts. Moreover, some of the men who have been promoted twice have, in fact, risen from operative rank to chargehand, and thence to junior foreman, whilst other men with only one promotion to their credit have risen from chargehand direct to senior foreman.

Because of the relative inadequacy of either of these criteria alone, it was decided to combine all the information available and thus produce a single composite criterion. A ten point scale was devised ranging from:

I Candidate promoted twice. Rises from junior post to very senior post. Reported as 'outstanding' in both posts.

II Candidate promoted twice. Rises from operative or acting junior post to senior post. Reported as 'very good' in first post and at least as 'good' in second post.

or

Candidate promoted once. Rises from junior to moderately senior post. Reported as 'outstanding' or 'very good' in new post. Further promotion absent only because of lack of vacancies.

through:

VI Candidate promoted once. Rises from operative to junior post. Reported as at least 'above average' in new post. Further promotion possible.

to:

IX Candidate not promoted during the 4½ year period.

X Candidate promoted and demoted.

The authors independently sorted the men into these grades. The correlation between their independent sortings was .94. The cases of discrepancy were discussed and a final agreed distribution was obtained:

Category	I	II	III	IV	V	VI	VII	VIII	IX	X	Total
Number of men	1	4	7	5	2	5	3	7	9	1	44

This criterion takes into account all the information available on the performance of the candidates, but as it is based in part on ratings by managers and in part on the incidence of promotion which is affected by chance factors such as the availability of vacancies, it would probably be reasonable to estimate its reliability as in the region of .6. (Evidence about the reliability of managers' gradings will be quoted later in this paper.)

The relationships between the composite criterion and its parts are:

		1	2	3	4
1	Managers' ratings at 1st follow-up ...		·71	·56	·84
2	Managers' ratings at 2nd follow-up...			·54	·86
3	Incidence of promotion				·75
4	Composite criterion				

(N = 44 in each case)

MANAGEMENT'S NORMAL METHODS OF SELECTION

One important part of the experiment was its attempt to compare customary methods of selection with selection based on more systematic techniques. Management's customary method of selection consisted of short interviews by the candidates' managers and discussion amongst managers who could be expected to know the men reasonably well. The results of the experimental evaluation of this method indicated that it was defective to a startling degree. Managers were required to sort the 110 candidates into four groups—'Outstanding', 'Confidently recommended', 'Adequate' and 'Unsuitable for promotion'. The distribution of the candidates amongst the groups was 2 : 12 : 29 : 67. The validity of the customary method of selection as measured by the correlation between these grades and the composite criterion based on achievement and job performance four years later, for the 44 candidates followed-up, was .18 ± .15. The result was slightly better for the 34 candidates 'accepted' by the customary method; the validity rose to .26 ± .16.

Possibly more startling is the relationship between intelligence test scores and the 'customary method' gradings; for the 110 candidates the correlation was .07 ± .09, *i.e.,* there was no relationship between intelligence test scores and the criterion by which management normally decided who was, and who was not, to be promoted.

This contrasts notably with the relationship between the composite criterion and intelligence test scores, .59 ± .10.

The relationship between candidates' ages and the results of management's normal selection method is interesting. The following table shows the numbers of candidates in various age ranges, and the proportion of men in each age range 'accepted' by the customary method of selection.

Age	21 to 26	27 to 35	36 to 44	45 and over	Total
Number of candidates	29	41	30	10	110
Percentage accepted	17	34	67	30	39

There was a marked tendency for this selection method to favour men in the age range 36 to 44. Was this tendency justified? Within the group of 44 candidates on whom follow-up data are available, the relationship between age and management's 'customary method' gradings was + .39: the relationship between age and the composite criterion, however, was

−.33. It would seem, therefore, that the preference for older candidates was unjustified.

The foregoing indicates the very low validity of management's customary method of selection. What evidence is there of the reliability of this method? As part of the experimental procedure, recommendation forms were filled up on each of the candidates; these were completed by each candidate's immediate superior and countersigned by the next senior supervisor. In a sense, therefore, these forms can be regarded as a systematisation of the customary method of selection. The correlation between the recommendation form gradings and the gradings arrived at by the customary method, however, was only .47 ± .07. (The recommendation form gradings again correlated zero with intelligence test scores, and only .26 with the final composite criterion.)

It would seem, therefore, that management's customary method of review and nomination was not only of very low validity, but was also unreliable in the sense that two methods of carrying it out produced considerably different results.

THE LIMITED USEFULNESS OF THE RECOMMENDATION FORMS

The recommendation form used in the experiment was, as has been indicated above, of very limited value. This contrasts markedly with the results, quoted by Vernon (1950) of enquiries into the value of confidential references in the selection of Civil Servants. Possibly the poor results were due to the design of the form. Too little time was available to permit the development of a really adequate form. The one used had three scales for 'Technical ability and aptitude', 'Co-operation and willingness' and 'Leadership qualities', each of these scales having three points and inviting further comments. The overall scale was a four point one and carried the greatest weight. It is possibly because of the very few intervals used in these scales and the consequent impossibility of comparing judges and thus correcting for undue leniency or strictness that the form showed such limited value. It seems more probable, however, that the zero correlation with intelligence was due to very different assumptions by the raters about the level of ability required for suitability as a supervisor. Better results can reasonably be expected if sufficient time is available to permit the training of the people filling in the recommendation forms. In this case the whole procedure had to be completed very quickly and no time was available to train raters.

PREDICTIVE EFFICIENCY OF INTELLIGENCE TESTS

The 110 candidates took two NIIP intelligence tests in the course of the experimental procedure, Group Test 33, a verbal test, and Group Test 70/23, a non-verbal test.

As has been indicated above, management's normal selection procedure correlated zero with intelligence test grades. The experimental procedure gradings, however, correlated positively with test scores and consequently the candidates who were accepted by this procedure were a selected group; thus the 44 candidates who emerged from both procedures, and on whom follow-up data are available, also include a higher proportion of above average test scores than is the case for the total population of 110 candidates. The following table, in which the figures are percentages, shows the extent of selectivity in each of the groups:

Intelligence Grade	110 candidates	34 men selected by management's customary method	28 men selected by experimental procedure	44 men on whom follow-up data are available
A ...	14	12	21	16
B ...	19	18	32	23
C ...	30	35	36	34
D ...	31	32	11	25
E ...	6	3	0	2
	100%	100%	100%	100%

(The follow-up group of 44 men consists of 10 who were picked by the experimental procedure only, 18 men who were picked by both methods, and 16 men who were picked by management's customary method but rejected by the experimental procedure.)

It is worth noting that the experimental procedure rejected a fairly high proportion of candidates with superior intelligence test results:

Intelligence grade	A	B	C	D	E	Total
Percentage of candidates with this grade rejected by experimental procedure ...	60	57	70	91	100	75

The value of the intelligence tests in the selection procedure is indicated by the fact that the correlation between test grades (GT 33 and GT 70/23 combined) and the final composite criterion for 44 men is .51, and correcting for selectivity, this rises to .59 ± .10.

The intercorrelations of the criterion with age, intelligence test scores, etc., were:

	1	2	3	4	5
1 Composite criterion ...		.52	.40	.51	−.33
2 GT 33 (verbal test) ...			.65		
3 GT 70/23 (non-verbal test)					
4 Combined scores on GT 33 and GT 70/23 ...					−.40
5 Age					

(N = 44 in each case. These correlations are not corrected for selectivity.)

THE CONTRIBUTION OF THE INTERVIEWS

Each of the 110 candidates was interviewed in the course of the experimental procedure by two independent interviewers. One interviewer saw all the candidates; the second interviews were distributed amongst five other interviewers, each of whom saw different numbers of candidates. In addition, the NIIP investigator sat in on 84 interviews by one or other of the management interviewers and recorded his independent judgment of the candidate's suitability; he personally conducted the second interview in 22 cases when no management representative was available. The management interviewers had previously been given about one day's training in interviewing technique by the NIIP investigator.

Interviewers had available to them (a) a biographical history sheet filled out by the candidate, (b) the recommendation form filled out by the candidate's immediate supervisor and countersigned by the next senior supervisor, and (c) the candidate's intelligence test results. To assist them to record their views interviewers were given record sheets set out in the manner of the 'Seven-Point Plan' (NIIP, 1952) which were intended as an aide-memoire during the course of the interview. Half an hour was allowed for each interview, although in some cases the interview was permitted to last longer.

The validities—corrected for selectivity—of the various interview gradings as measured by their prediction of the composite criterion for the 44 cases followed up, are given below. In the case of interviewers II, III and V too few of the candidates they saw are included in the follow-up group to permit the calculation of the separate validities. Their gradings have, therefore, been combined and the average validity is given. In the case of the NIIP interviewer, only 8 of the 44 cases were interviews conducted by himself, the remaining 36 cases are gradings made after observing interviews carried out by one or other of the managers.

	Validity of interview ratings	Number of cases in follow-up group	Number of candidates interviewed
Interviewer I	.55 ± .11	44	106
Interviewer IV	.66 ± .13	18	38
NIIP Interviewer	.61 ± .09	44	106
Interviewers II, III and V	.17 ± .23	18	43

The intercorrelations between interview ratings by the three interviewers who achieved moderately high validities were:

	r	Number of interviews
Interviewer I *vs.* Interviewer IV	.65	38
Interviewer I *vs.* NIIP Interviewer	.66	106
NIIP Interviewer *vs.* Interviewer IV	.90	38

The last of these correlations is between ratings made by the interviewer and the NIIP investigator observing the same interview. The other two correlations represent agreement between interviewers conducting independent interviews.

Taking all the data on agreement between interviewers (including II, III and V), which may be considered as a measure of the reliability of the interviews, independent interviewers achieved an average intercorrelation of .61 with a range of .2 to .7; two raters independently rating on the same interview achieved an average intercorrelation of .73 with a range of .6 to .9. These figures are very much in agreement with the results of previous studies (see, for example, Vernon (1953)), although in this case the validities of the interviews are higher than is apparently usual.

PANEL REVIEW OF INFORMATION ON CANDIDATES AT THIS STAGE

On completion of the interviews, the panel of managers came to an agreed grading for each candidate, based on all the information at their disposal, *i.e.*, biographical history sheet, recommendation form, test results, and interview gradings by three interviewers.

106 men survived to this point in the procedure. The distribution of gradings by the panel at the end of their deliberations was:

Panel grading	A	B	C	D	E	Total
Number of candidates obtaining this grade	12	31	34	24	5	106

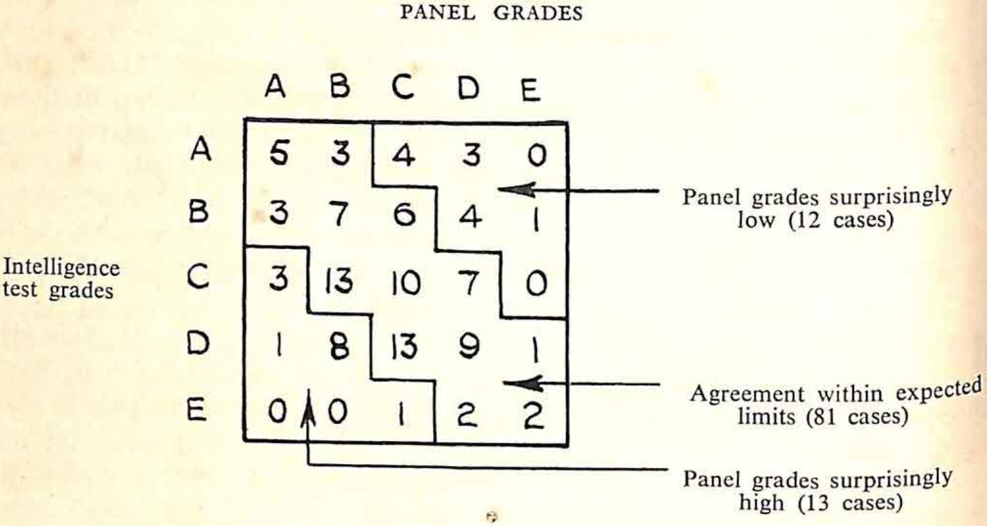
The validity of this grading as measured by its prediction of the combined criterion grade four and a half years later, for the 44 men followed up, is ·55 ± .10.

Although this is lower than the .59 achieved by the intelligence tests alone, in view of the unreliability of the criterion and of the interview gradings, it is worth estimating the validity of the panel grades when these unreliabilities are corrected. Since the criterion includes management ratings, and managers' ratings based on interviews agree only to the extent of .6, it is reasonable to assume that the criterion reliability is somewhere in the region of .6. Therefore, if the interview grading and the criterion reliabilities were raised to .95 by increasing the number of interviewers and the number of managers assessing the candidate's job performance, the validity of the interview would rise to .87 (by formula for correction for attenuation). To achieve this, however, it would be necessary to have 13 interviewers, which would be economically unreasonable, and 13 managers who knew the men well, giving assessments of their job performance, which is quite impracticable.

Correcting the prediction of the intelligence test gradings for unreliability of both test scores and criterion, the coefficient corrected for attenuation is .78.

RELATION OF THE PANEL'S GRADINGS TO INTELLIGENCE TEST SCORES

The correlation between the agreed grades by the panel (when intelligence test results and all other information is taken into account) and intelligence test grades is only .35 ± .09. The following diagram indicates the numbers of cases where agreement is what might have been expected, where the panel grades are surprisingly low in view of the test results, and where the panel grades are surprisingly high in view of the test results.



PANEL GRADES

Intelligence test grades

	A	B	C	D	E
A	5	3	4	3	0
B	3	7	6	4	1
C	3	13	10	7	0
D	1	8	13	9	1
E	0	0	1	2	2

Panel grades surprisingly low (12 cases)

Agreement within expected limits (81 cases)

Panel grades surprisingly high (13 cases)

In the case of the men whose panel grades were surprisingly low, five of the twelve were under 24 years old and comments by interviewers indicate that they were rejected because it was felt that they were immature, *e.g.*, 'immature and inarticulate', 'an intelligent youth but no drive or initiative', 'adolescent'. The remaining seven do not fall clearly into any distinct category; one was a man with a very unusual background and the interviewers disagreed completely in their assessments of him, two were regarded as 'rather insignificant—no signs of leadership ability', one man was commented on very favourably and it is difficult to see why he was graded D, and the records shed no light on the three other cases.

In the case of the thirteen men whose panel gradings were surprisingly high, there is no marked relationship between age and grades, although the group contains twice as many men in the age range 33 to 39 as would be expected by chance. The interviewers' comments suggest that the favourable impression created by the manner and bearing, and personal reputation of these men was allowed to override doubts about their intellectual calibre, *e.g.*, 'good interest pattern', 'excellent record', 'a good tradesman, clean, tidy and alert', 'very conscientious', 'excellent Service record', 'a brisk, alert, pleasant man; a good mixer', 'a very sound chap, pleasant manner and appearance, full of drive and very sure of himself, adequate intelligence'.

Only one of the cases in which the panel gradings was surprisingly low was included in the follow-up group; in this case the man did very well and the panel grading was unjustifiably low. Data are available on five of the thirteen men whose panel grades were surprisingly high in view of their test scores—two of these men justified their panel grades, three did not.

The panel grades correlate zero (+.004) with age, although age correlates −.3 with the criterion. This at least is an improvement on management's customary method gradings which correlated +.3 with age.

THE RELIABILITY AND VALIDITY OF THE GROUP DISCUSSION SESSIONS

The experimental procedure had two parts. Part I, which has been discussed above, consisted of the consideration of recommendation forms, application of intelligence tests, and interview. Part II consisted of three group discussions for each candidate. Only candidates who were regarded as above average in Part I were allowed to proceed to Part II; in fact, the upper 40 per cent. of the candidates, as decided by the panel gradings at the end of Part I, took part in the group sessions. (6 men with A or B grades in Part I were excluded for extraneous reasons—sickness, etc.)

Thus 44 selected men were subjected to further screening by means of group methods. It should be noted that these 44 are *not* the same as the follow-up group of 44; the equal numbers arise by coincidence. In fact, follow-up data are available on only 28 of the men who took part in the group sessions.

The candidates were divided into five groups of nine, roughly according to their ages, and the age ranges in each group were:

Group A	Group B	Group C	Group D	Group E
41 to 46	33 to 40	30 to 35	24 to 30	21 to 24

Each group met for a period of three hours during which (i) they held a free discussion on a subject such as 'The National Health Service', (ii) a discussion on a technical subject such as 'Rate Fixing', and (iii) a discussion on a subject relating to personnel practice, 'Apprentice training and its obligation to produce more than technical competence'. Each of the discussions was observed by two managers and the NIIP investigator, who watched the way in which the candidates interacted to see which men were accepted as leaders, which men made sensible and constructive contributions, which made stupid and destructive contributions, and so on.

Each observer independently rated each candidate on completion of each discussion, and at the end of the three-hour session each observer rated the candidates for the whole of the three discussions. Finally, the observers discussed their overall ratings and arrived at an agreed rating for each candidate. A five-point scale was used for each of the gradings and, in addition, each observer placed the candidates in rank order for their overall performance in the three discussions.

The agreements between gradings by different observers in the three discussions were:

	Average r between any two observers	Range of r's
'Free' discussion ...	.55 ...	.4 to .6
Technical subject discussion ...	.68 ...	.6 to .7
Personnel subject discussion ...	.66 ...	.6 to .7

These intercorrelations indicate that ratings based on any one of the discussions are of low reliability. However, the ratings by each observer in each of the three discussions are positively correlated, *i.e.*, each observer tended to approve of the same candidates in each of the three discussions. The average intercorrelations of ratings by the same observer in the three different discussions were:

	Average r	Range of r's
'Free' discussion *vs.* Technical subject discussion	.70	.6 to .8
'Free' discussion *vs.* Personnel subject discussion	.65	.5 to .7
Technical subject discussion *vs.* Personnel subject discussion	.72	.65 to .75

It is to be expected that when each observer summarised his ratings for the three discussions there would be greater agreement between observers than when each discussion is taken separately. This was, in fact, the case; the average intercorrelation between ratings by any two observers considering the three discussions together, was .73 with a range of .69 to .78. This is a notable improvement on the agreement between interviewers, despite the fact that the candidates in the discussions were the upper two-fifths of the candidates interviewed, and were, therefore, a much more homogeneous group. (The estimated agreement between observers had all 110 candidates been included in the discussion sessions is .87.)

Each observer put the 9 candidates in rank order after each session of three discussions. As the groups had been selected in such a way as to restrict the age range within groups, it is to be expected that observers would be able to agree more closely about the rank order of candidates in each group than they would agree about the letter grades to be allocated to candidates drawn from different groups. This was, in fact, the case; the average rank order correlation between any two observers was .78 with a range of .33 to .97. The gain in agreement is remarkably small in view of the fact that in awarding the letter gradings observers had to carry subjective standards of performance in their minds for a period of several days, whereas in giving rank orders they had no need to remember standards of performance in other groups.

It is clear from the above that the group discussion technique provided considerably more reliable gradings than did the interview. The validity of these gradings has, unfortunately, to be estimated from a sample of only 28 cases. The validity coefficient of the agreed grades by the panel of observers taking three discussions into account for each candidate, is .50, and correcting for selectivity this rises to .58 ± .12, that is these gradings are slightly more valid than those based on the Panel gradings based on the interviews, etc., at the end of Part I of the experimental procedure.

However, the group discussion technique is considerably more expensive in terms of man-hours:

9 candidates interviewed by two interviewers for half an hour each = 9 candidate hours + 9 interviewer hours; and allowing for waiting time, etc., this is approximately 20 man hours.

9 candidates observed in three discussions by 3 observers = 27 candidate hours + 9 observer hours, no waiting allowance is necessary; this totals 36 man hours.

The management time is approximately equal in each case, but the cost of the candidates' time is nearly three times as high by the discussion technique. This is a considerable disadvantage when the selection is from candidates drawn from within the firm, who are being paid their normal wages for time spent on selection procedures. There is good reason, therefore, to use the discussion technique as the second hurdle rather than the first hurdle in the selection procedure.

WHAT DID THE GROUP SESSIONS MEASURE?

The aim of the group procedures was to observe the candidates in a social setting, and thus to obtain some measure of personality factors, such as acceptability to others, co-operativeness, intelligence, persuasiveness and leadership. As has been indicated, the observers attained a reasonable degree of agreement in their ratings of the candidates by the end of the sessions, but this does not necessarily mean that they were agreeing about the personality factors that it was hoped the group sessions would measure. The following table indicates the correlations between some items in the Part I procedure and the agreed Panel gradings at the end of the group sessions.

Agreed Panel Gradings at the end of the Group Sessions correlate with:

	Raw r (N=44 in each case)	r corrected for selectivity	r corrected for selectivity and attenuation
Age of candidates	—.275	—.28	—.31
GT 33 (verbal test)	·48	·55	.63
GT 70/23 (non-verbal test) ...	.26	·30	·34
Combined GT 33 and GT 70/23	·34	·39	·44
Panel grade at end of Part I (interviews, tests, etc.)	·51	.69	·95

It would seem, therefore, that the group sessions measured very much the same personality characteristics as did the interviews, when allowance is made for the unreliability of the two procedures, *i.e.*, lack of agreement between interviewers, and between group session observers. The group sessions, however, measured these characteristics rather more reliably, *i.e.*, the observers agreed more amongst themselves than did the interviewers, despite the fact that they were dealing with a more selected group. (It should be noted that the observers in the group sessions were the managers who had conducted the interviews, but they did not necessarily observe the group sessions of those candidates that they had themselves interviewed.)

THE VALIDITY OF THE EXPERIMENTAL PROCEDURE AS A WHOLE

On completion of the discussion groups, the panel of managers and the NIIP investigator reviewed all the evidence and graded the candidates for suitability for promotion; a five-point rating scale was used. The validity coefficient of these ratings was .65, and correcting for selectivity this rises to .72 ± .09. Estimating the reliability of the criterion at .65 and the reliability of the final gradings at the end of the whole experimental procedure at .95, the validity of the procedure when allowance is made for the degrees of unreliability of the two procedures (*i.e.*, the amount of disagreement between observers and between interviewers) was .92; *i.e.*, the experimental procedure was predicting so well that little improvement could be obtained except by improving the reliability of the criterion.

The validity of the whole procedure as measured by the parts of the composite criterion was:

Whole procedure predicted grades by managers 4½ years later	.61 ± .12
Whole procedure predicted Incidence of Promotion (once, twice, or none)	.66 ± .11
Whole procedure predicted the composite criterion 4½ years later	.72 ± .09

IMPLICATIONS FOR INDUSTRY OF THESE FINDINGS

During the survey carried out by the Foremanship Research Group between 1948 and 1950, ratings by managers on over 400 supervisors were collected. The following distribution was obtained:

First class	16%
Good	41%
Satisfactory	32%
Rather weak	10%
Definitely unsatisfactory	1%

If it can be assumed that the validity of the selection procedures by which these men were chosen was .3 (in the experiment described above, the validity of the normal selection procedure used by management was under .2), and if there are about three candidates for every vacancy (in the case described above there were), then by the introduction of selection procedures valid at the .7 level, the distribution of ratings (Taylor & Russell, 1939) would be:

First class	26%
Good	53%
Satisfactory	19%
Rather weak	2%
Definitely unsatisfactory	0%

An improvement of this order might well make a substantial contribution to improved industrial efficiency. It must be borne in mind, however, that the factory in which this experiment was conducted employed a high proportion of skilled men, and not all factories may be as fortunate in having a substantial reserve of men of superior ability.

IMPLICATIONS FOR THE OCCUPATIONAL PSYCHOLOGIST

It appears from this experiment that a combination of existing, fairly elementary, selection techniques permits prediction of supervisory success —as measured by management criteria—just about as well as the uncertainties of the criteria allow. The improvement of criteria obviously demands priority for research. Nevertheless, there is a need to improve the economic efficiency of the selection methods. The cost in man hours of the techniques used in this experiment is heavy, as is shown by the following table of man-hours spent per 100 candidates applying:

For 100 *candidates applying*

		Candidate hours (approximately)	Management hours	Validity
Recommendation forms	Filled in by immediate supervisor — say, 20 minutes each. Checked and counter-signed by next senior supervisor — say, 10 minutes each		50	.26
Intelligence tests GT 33 and GT 70/23	Candidates in groups of about 30. 1¼ hours for each group	125	6	
	Scoring and preparation of lists of scores—say, 6 minutes for each candidate		10	·59
Interviews	Each candidate interviewed twice for about half an hour. One additional observer sitting in on one of the interviews	100	150	.17 to .66
Panel review of results	Managers involved consider all the above and rate the candidates. Meeting last about 2½ hours		7	·55
Group discussions for best 40% of candidates	3 hours per group, with candidates in groups of about 9. Three managers observe each session	120	40	·58
Panel review all the evidence and promulgate results			7	·72
Total cost in hours		345	270	

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In addition, of course, management time is spent in advertising vacancies; preparing job specifications; issuing application forms; designing, issuing and collecting recommendation forms, etc. Thus a reasonable estimate of the cost of the selection scheme is 3½ candidate hours and 3 manager hours for each candidate. This is somewhat formidable in comparison with the 20 candidate minutes and ½ a manager hour for each candidate, taken by the customary method of review and nomination. While it is very probable that ultimate savings in terms of increased efficiency will amply repay the additional time spent on selection by the more valid method, it is easy to understand management reluctance to accept the high initial cost of time involved.

The obvious sources of economy and improvement are (i) designing a better recommendation form for completion by candidates' superiors, (ii) the abandonment of the non-verbal intelligence test, which did not add anything to the results achieved by the verbal test alone—saving about ½ an hour on each candidate, and (iii) the improvement of the reliability of the interview. It should be emphasised that in the case of this experiment the interviewers were relatively untrained and no pressure was placed on them to take the results of the intelligence tests seriously, for at the time of the experiment the value of intelligence tests in the selection of supervisors was unknown.

SUMMARY

This paper describes an experiment in the selection of supervisors for a heavy engineering factory. 110 candidates were screened (a) by the normal procedure customarily employed by the firm, and (b) by means of an experimental selection procedure.

Results based on following up the men accepted by both methods four and a half years later indicate (i) that the customary method provides very poor prediction and also rejects a large proportion of candidates who would have been superior, (ii) that the experimental procedure brings forward a higher proportion of men who prove to be superior and provides good prediction of the level of success candidates will achieve.

The reliability and validity of the interviews and group procedures used in the experiment are discussed and suggestions are made about methods of improvement.

One result of a general improvement in the selection of supervisors to the level achieved in this experiment would be a substantial increase in the number of supervisors rated highly by their managers. An estimate of the size of this improvement is given.

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Conflict and Authority in Industry

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A GREAT deal of research has been undertaken in recent years, both in Britain and America, into the elimination of conflict in industry, especially between those in authority and those in subordinate roles, and between different groups and associations within industry. Outstanding among these researches are the investigations made on behalf of the Human Factors Panel of the Committee on Industrial Productivity under the chairmanship of Sir George Schuster. These enquiries include the two studies undertaken by the NIIP (1951, 1952) (that of the role of the foreman in industry and the extensive study of joint consultation), the study of social change in the Glacier Metal Company by the Tavistock Institute (1951) and the studies of industrial leadership and joint consultation made by the University of Liverpool (1952). An examination of these and similar reports suggests that implicit in most of them are certain value judgments concerning the effects of conflict in industry.

These underlying assumptions appear to be, firstly, that the absence of industrial conflict is a desirable end in itself and that harmonious relationships between individuals and groups participating in economic organizations should be promoted for their own sake. In other words, the aim of joint consultation and similar procedures is to create greater social solidarity or integration in industry. Secondly, it appears to be assumed that social integration will itself be an important factor promoting greater productivity. This point of view is ably expressed by Sir George Schuster in his introduction to the NIIP study of joint consultation when he says, "Joint Consultative methods are a means to an end — the end of making each industrial unit a harmonious, live, co-operating community working together with a sense of common purpose which is understood and accepted by all its members". It is implied that such a state of affairs, if it could be created, would naturally result in greater productive efficiency. It is highly desirable that both these assumptions should be subjected to critical examination.

THE NATURE AND ORIGINS OF CONFLICT

A study of the nature and origins of conflict from the sociological point of view suggests that conflict is an inevitable concomitant of change. Only in a completely static society can conflict be altogether eliminated. The highest degrees of social integration are found among primitive societies, small and isolated from cultural contacts, bound by tradition and held together by ties of kinship and tribal authority, which have remained relatively unchanged over a long period. Examples of such closely integrated societies are fast disappearing, not least as a result of the social changes set in motion by the contact with research anthropologists and other representatives of an alien western culture. The values of western democracy place considerable importance upon the idea of progress, even though it may be difficult to obtain agreement as to how exactly progress is to be assessed or defined. Changes in the technological aspects of western culture are taking place at a tremendous pace and from them follow repercussions in economic, social and cultural life, with bewildering consequences for all concerned. The conflict arising from such social changes can be observed at three levels in Society. There is the conflict at the institutional level between the older order and the new, the gradual modification of the social and economic structure to meet the changing technological conditions; there is conflict at the cultural level between the values associated with the old order and the new, between, for example, the beliefs and practices, or the personal and social ethics appropriate to a steam age and those appropriate to an atomic age; finally there is conflict at the level of individual personality, and between persons and groups. The sense of status and security achieved by individuals and social groups at one level of partial integration may be undermined by social change. The consequent insecurity and anxiety brought about by the changing conditions may result in expression of hostility and aggression towards the changes and towards those believed to be responsible for them. This is observed time and time again in the economic history of Britain and other countries. Each new change in the technological or economic system has been resisted by those whose sense of security rested in the stability of the old ways. Often the strongest resistance to change has come from the employees, sometimes from employers and managers.

Even the introduction of joint consultation, which is itself intended to promote greater harmony, may set in motion changes in the status relationships within the factory which themselves produce a conflict situation. Scott (1952, pp. 150-151) has drawn attention to this in his studies among Merseyside firms. He states, "In many cases the system has increased the insecurity feelings of intermediate and lower management, and so far as rank and file are concerned, the institution of joint consultation between higher management and employee representatives has probably increased their dissatisfaction with the authoritarian regime which they experience on the shop floor. . . . The representative tends to become involved in a conflict of roles and loyalties". Jaques (1951, p. 204) quotes another example resulting from the introduction into the Glacier Metal Company of consultative procedures. Referring to some diminution of the authority of superintendents resulting in loss of status, he says, "This sense of loss of status and authority was intensified by the setting up of the joint consultative system allowing for direct contact between top management and the workers' representatives, and leaving the superintendents feeling squeezed out, for they had not approved of the new set up from the beginning. The inclusion of the superintendents in the new consultative machinery by establishing a 'democratic' Superintendents' Committee, which was given one place on the Works Council, did not obviate the difficulties, and in some ways made matters worse". It can be seen that the failure to recognise the inevitability of certain types of conflict in industry is the result of an unduly static analysis of social integration, which does not take into account the question of social change.

The second assumption, namely, that a high degree of social integration resulting from an absence of conflict between individuals and groups will result in higher productive efficiency, also requires examination. The belief that social integration and harmony promote greater productivity rests upon the assumption that those who participate in an industrial organization share certain values concerning the importance of maximizing material wealth, individual and corporate. These value premises are not common to all societies at all times. There are some places where leisure is more highly valued than money and the things that money can buy. In such circumstances men and women will work just so hard, and for so long, as they can earn enough for their subsistence. After that no further incentive will encourage them to work longer or produce more. There is evidence that the marginal utility of leisure is becoming greater in our own society. In this situation it is only the unstable neurotic individual who endeavours to break production records in an attempt to reduce his own anxiety feelings. The 'rate-buster' mentality may be encouraged in the Soviet Union, although it is not a sign of social integration and harmonious relationships, but rather the reverse. Harmony and social integration are not therefore necessary concomitants of higher productive efficiency. In fact conflict, in its institutionalized form of competition, may be a stimulus to initiative and effort and as such an important element in any successful incentive system. Scott (1952, p. 156) points out that, when high morale is identified with employee satisfaction, "It may be that in many instances increased employee satisfaction has led to increased effort, but it does not appear that this should necessarily occur . . . the satisfaction occurring from the attainment of a personal goal, say, increased reward, may not lead to greater effort directed towards the more efficient attainment of an objective of the group as a whole, such as production".

The importance of understanding the part played by conflict in any sociological analysis of human relations has been emphasised by other writers such as Bernard (1950, 1951) and Sorenson (1951). The preoccupation with psychological aspects among those concerned with 'human relations in industry' has led to an unrealistic avoidance of the problem of conflict or to naive assumptions concerning its elimination. There has been a tendency to assume that there is no real conflict of interests between labour and management and that the adoption of the right kind of technique by an enlightened personnel department will create a state of harmony in which workers and management alike will collaborate in the pursuit of the manifest objectives of the organization. Such an approach fails to recognise that conflict, as understood in the sociological sense, can exist independently of the subjective reactions of the members of a group. Friendly relations may exist between the man on the bench and the Works Manager or the Chairman of Directors, but this does not alter the fact that the interests of the employee in maintaining his job are not the same as the interests of the employer in employing him, as will be quickly shown at a time of trade depression. Conflict in this sense is embedded in the institutional structure of society and is not removed, however enlightened the management. In this particular case the production of particular goods or services represents the manifest purpose of the organization — the shared collective goal. The employer and those associated with the management have additional goals arising out of the need to maximize efficiency, reduce costs, and maintain profit levels and dividends. The employees, on the other hand, are concerned with the security of their employment, the protection or increase in the size of their wage packet and a number of other personal and social satisfactions derived from their occupation.

In addition to the conflict between groups there may also arise 'role conflicts' within the personality of the individual as a result of his membership of more than one social group. Thus the manager may be torn between a feeling of responsibility towards his employees, involving a reluctance to dismiss men or reduce wages, and his responsibility towards shareholders. Similarly, an employee may feel conflict between his role as a Trade Union member, seeking increased wages, and his role as a loyal member of the industrial organization concerned, whose survival depends upon the reduction of costs. At times of national economic crisis these feelings may be reinforced by a sense of duty towards the community at large.

The existence of these conflicts is some measure of the lack of integration in the social and economic system as a whole. The process of collective bargaining in industry between the representatives of workers and management is typical of the utilization of the conflict situation for constructive purposes. The whole history of the Trade Union movement is a reflection of the way in which the process of conflict, in the long run, can be made to serve the better interests of both parties to the dispute, as well as the community at large. It is not difficult to conceive the extent to which progress in industry would have been retarded had employees in the rapidly growing industries of the nineteenth century acquiesced in their exploitation by the growing capitalist class. It would be wrong to assume that a conflict situation, in this sociological sense, is necessarily or always incompatible with effective co-ordination. The classical discussion of the nature of conflict by Simmel (1904) makes it clear that without the conflict of opposition there would result accommodative attitudes and relationships which would lead to the subordination of one group to another rather than the working out of a mutually acceptable agreement.

There are numerous points in the economic and industrial structure of society where conflict may arise. There may be conflict between the goals pursued by a particular firm and those pursued by Society as expressed through the State. Thus laws prevent or restrict the production of certain kinds of product (such as opium) and govern the conditions under which all goods and services are produced. There may be conflict between the firm and the goals of the industry as a whole as represented by employers' federations or monopolistic organizations. There may be a conflict between the goals of the firm and those of other groups and associations (such as Trade Unions) within the firm. Finally, there may be conflict between the private goals of owners, managers, supervisors and the rank and file personnel, as well as between these private goals and the shared collective goals of the members of the organization as a whole. The actual consequences of conflict of this kind can be evaluated in the light of any one of these particular points of view. For practical purposes it is usual for the industrial sociologist or psychologist to take the manifest purposes of the firm, the shared collective goal of production, as his standard of value and to consider the social relationships in the organization from this point of view. Conflict within a firm may therefore be designated as *re-integrating* (constructive) or *dis-integrating* (destructive) in the light of its influence upon productive efficiency. Mary Parker Follett (1949) has pointed out the possibility of constructive conflict in industry although she also appears to take a somewhat optimistic view of the extent to which conflict can be eliminated.

One of the most frequent sources of dis-integrating conflict is that which arises when there is incompatibility between the manifest objectives of the organization (shared collective goal of production) and the latent objectives (personal and social satisfactions) of the members. This is a truth which has been readily grasped by the industrial psychologists of the 'human relations' school. The latter sometimes make the mistake of assuming that *all* conflicts can be resolved by the simple process of ensuring that the work situation provides the employee with an opportunity for self expression, primary group membership and status recognition. Such an approach ignores the institutional aspects of conflict already discussed and fails to acknowledge the place of re-integrating conflict.

A typical example of the way in which dis-integrating conflict arises may be seen in the incompatibility between the manifest and latent objectives of a bureaucratic structure. Max Weber (1947) recognised that the development of bureaucracy was an inevitable and even a desirable accompaniment of the institutionalization of rational legal authority. As understood by Weber, bureaucracy meant the exercise of control by a hierarchy of officials on the basis of knowledge. While he did not subject the phenomenon to a detailed examination, Weber did refer to the danger accompanying a bureaucratic structure, namely, the tendency of the officials to allow a concern with their own interests and security to interfere with the effective fulfilment of the manifest objective of the organization. This tendency he described as 'formalism' (p. 312). The establishment of rigid codes of behaviour and ritual, especially with regard to questions of status, is a by-product of this situation. The procedures are usually rationalized on the grounds of discipline or (as in the case of the Civil Service) the importance of preventing errors of judgment by individuals. The most outstanding examples of such ritualization are to be found in the general administration of armed forces which assumes all the characteristics of a formalized bureaucracy, or the nationalized boards which consist of a monopoly surrounded by an atmosphere of pseudo-public service, self perpetuating, secure because it is outside competition and having legal status in perpetuity.

PROBLEM OF AUTHORITY

A further source of dis-integrating conflict is that which arises as a result of dominative authority. The administrative staff of any corporate body is faced with the problem of co-ordinating the efforts of its members without at the same time creating tensions and conflicts which will interfere with the achievement of the manifest purposes of the organization. The functions of the executive role include recruitment, allocation of duties and the organization of production, the provision of machinery and tools, the remuneration of personnel and the disposal of the product or service. The larger and more differentiated the organization the greater is the need for co-ordination by a manager exercising authority. The problem of authority is central to sociology and has occupied an important place in its literature. One of the most penetrating analyses of authority from the sociological point of view is that of Max Weber (1947), who in his discussion of *legitimacy* has thrown light upon an important practical as well as theoretical problem. His discussion of legitimate authority is inadequate, however, because it fails to incorporate into the analysis the essentially psychological aspects of the problem. Weber's interests lay in the problems of institutional change. On the whole he was not interested in psychology and tended to deny its relevance to sociological problems. This was not perhaps surprising in the light of psychological knowledge at the time that he was writing. Yet, a theory of social action is not complete without its psychological components. Both institutional factors and personality factors must be taken into account in the study of human relations in industry and both must be related to the value systems shared by the members of the groups concerned.

An examination of the psychological aspects of authority shows that the attitudes generated, especially by authority of the dominative type, are often ambivalent. The exercise of their powers by those in authority involves frustrating some of the private goals held by members of the organization in order to ensure the more effective fulfilment of the shared collective goals. It is this frustration which is liable to generate hostility towards the source of authority and aggressive attitudes of varying kinds. Depending upon the personality characteristics of the subordinates and the extent of deprivation and punishment that would arise from a direct defiance of authority, the hostile attitudes may be directly expressed, displaced upon another object, or turned in upon the self. In other circumstances subordinates may prefer to abdicate personal responsibility in favour of dependence upon the source of authority. This response is often the consequence of feelings of insecurity. In any case the exercise of authority, especially if this involves any large degree of coercion or domination, is liable to create stresses and strains within the personalities of subordinates and, not least in importance, conflicts within the personalities of those exercising authority. This is brought out very clearly by Jaques (1951, pp. 276-7) in his discussion of dominance and dependence. He points out that having authority provides the leader with an outlet for expressing his own power, and he states, "This arouses whatever internal conflicts may surround his sense of power, such as conflict between unconscious doubts about personal capacities and ideas of omnipotence. The co-existence of such opposites tends in practice to make it difficult to develop a balanced attitude towards using authority. Having a position of dominance stirs latent wishes to dominate for the sake of power itself as well as for the requirements of the job. But to the extent that dominance is used for personal gratification, a profound sense of guilt ensues. Conflicts are engendered inside the individual himself, which may be increased if he feels himself to be in conflict with the accepted patterns of British culture".

Dis-integrating conflict arising from dominative authority will be at a minimum in those circumstances where a common value system unites the members into a closely integrated group in which private goals are willingly subordinated to the shared collective goals in the interests of the solidarity of the organization itself. That is to say, the members must feel a loyalty towards the organization and a responsibility for the achievement of its manifest objectives which over-rule the desire to pursue private goals. Solidarity is the result of the institutionalization of the common value system. In such a situation each individual behaves in the way which is expected of him by his fellows and by those in authority. The same applies to the action of smaller groups within the main organization. All accept a set of harmonious rules governing goals and procedures which are themselves derived from the common value system and governed by it. When a situation arises in which there is some uncertainty about the right course of action an examination of the manifest objectives and the common value system normally clarifies the situation.

Such a common value system may be accepted on grounds of tradition, expediency, political or religious idealism or for a number of other reasons. The result in all such cases is loyalty to the organization which enables its leaders to exercise authority and make demands upon the members with which they willingly comply, without setting in motion the dis-integrating conflicts which would otherwise ensue.

A great deal has been written in recent years about the need for 'democratic participation' in industry and the need for some executive and advisory functions to be undertaken by joint committees of employees and managers. A system of democracy, based upon the rule of the majority, is dependent, if it is to be effective, upon the acceptance, in some measure, of a common value system in which the manifest objectives of the organization are regarded by all the members as of considerable importance. If this is not so the democratic machinery, which rests upon the consent of the minority to be ruled by the majority, will eventually break down. It is difficult to see how the parliamentary system, or even a board of directors, could operate if those over-ruled were actively to sabotage the rule of the majority.

But the recognition of the legitimacy of authority in this context is a matter of degree. The very fact of voting procedures is a recognition that differences and therefore conflicts exist between the members. Only when the degree of agreement on objectives and the methods of carrying them out is very high is it possible to do away with voting procedures altogether and adopt instead the principle of unanimous consent, as in Quaker business meetings, or in the consultative committees of the Glacier Metal Company. In both these cases the absence of voting and other formalities normally found in committee meetings imposes a self-discipline upon those participating which contributes greatly to the effectiveness of the organization in question. If a member chooses persistently to abuse this system, in which greater freedom of expression is given to the individual and unanimous consent sought, then disciplinary measures may have to be taken against the offending member. These will normally take the form of pressure to conform brought by the group as a whole, or its representatives, through rational argument or by the application of some kind of sanction. In the last resort, if the disciplinary measures are not successful, the individual may have to be expelled from membership of the organization, if the latter is to preserve its existing procedures and objectives. Alternatively it would be necessary to revert to a system of majority rule. The logical concomitant of the principle of unanimous consent is that of the veto. It is not difficult to see how the failure to reach agreement in the United Nations Assembly is due to the absence of any commonly accepted value system, or any agreement upon the manifest purposes of the organization and how they are to be carried out. A similar analysis applies to an industrial organization seeking to achieve the active consent and participation of its members in changes taking place, if such common agreement does not exist.

Experience has shown that the existence of a formal democratic structure is not by itself sufficient to achieve effective co-ordination or eliminate dis-integrating conflicts. The imposition of a system of joint consultation between management and workers in industry, in the absence of a commonly accepted value system in which the manifest objectives of the organization are held by both above personal and group interests, is bound to be abortive. This is clearly seen in the history of joint consultation in industry since before the first world war, to the present day. In the circumstances of war both employers and employees are prepared to subordinate their respective interests in the face of the overwhelming need to maximize production at all costs, to help the war effort. In such a situation, joint production committees flourish and make a valuable contribution to increasing the effectiveness of the organization of production. Once the war period is over the common scale of values tends to disappear and the sectional interests of management and labour assert themselves again. In such circumstances systems of joint consultation tend to cease functioning, or at best become an ineffective routine that does not succeed in overcoming the latent conflict.

These conclusions are amply borne out by the Schuster Panel investigations, especially by those in the three Merseyside firms. Scott (1952) emphasizes the actual and potential conflict between Unionization and the development of internal joint consultation and points out that both Union and non-Union employees tend to belittle the value of joint organization, although for different reasons (p. 147). He points out that the purpose underlying the extension of joint consultation has been to achieve more co-operative or more harmonious relationships, but he is doubtful if a committee system can contribute substantially to such an objective (p. 149). Later (p. 166) he suggests "It would be idle to pretend . . . that it will be easy to integrate the 'Union' and 'internal' approaches to consultation for . . . inter-Union antagonisms constitute another problem". Scott sums up his conclusions by saying (p. 170) that the introduction of formal joint consultation "can of itself make only a very limited contribution to the improvement of industrial relationships. Yet this small measure of success is unlikely to be achieved unless its introduction signifies, or is accompanied by some change of attitude on the part of those involved". He emphasizes that this change of attitude will only result from changes in the values of the individual and the group, which are derived from the cultural milieu.

CONCLUSION

The conclusions to be derived from this discussion of conflict and authority in industry may be summed up as follows. Not all forms of conflict in industry can or should be eliminated. Conflict is an inevitable consequence of social change, and to attempt to eliminate it in all circumstances, for the sake of social harmony and integration, can only have an inhibiting effect upon the introduction of new methods and procedures themselves designed to produce greater productive efficiency. There are, however, certain types of dis-integrating conflict, especially those emanating from dominative authority, which can be avoided. But the mere introduction of democratic forms of consultative procedure will not be sufficient to eliminate conflict of this kind, unless attitudes and values are also changed. Research on joint consultation seems to suggest that where a sense of common purpose is felt, formal consultative procedures are largely unnecessary because informal consultation at all levels will be taking place in any case. Similarly, the introduction of formal procedures where there is no common value system will probably intensify conflicts between private goals and between the goals pursued by other groups and associations within the firm. Further research is required to enable the distinction to be made in all cases between re-integrating and dis-integrating conflict.

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Seven Problems of Synthesis in Vocational Guidance

By E. MIRA Y. LOPEZ

Professor Mira (Rio de Janeiro) read this paper in French at a Plenary session of the Vocational Guidance Section of the International Congress of Psychotechnics held in Paris in July, 1953. The translation is by Miss R. M. Harris, of the National Institute of Industrial Psychology.

THE day I gave my first vocational guidance consultation to a young apprentice from the Escola del Treball in Barcelona is lost in the mists that have gathered round my memories of the year 1919 and thereabouts, but the emotion I felt in reflecting that on my advice might depend the subsequent fate of that young man — whether happiness or unhappiness would be uppermost in his life—is with me still, after thirty-four years crowded with events and rich in experience. Between that day and this the situation has been repeated almost twenty thousand times, for apart from a few brief periods occupied by travelling, illness or exile, I have had to deal with it three times daily. The responsibility which I feel continues to weigh heavily upon me.

It is certainly not difficult to send a subject away satisfied from his interview, but it is difficult to feel fully convinced in one's own mind that sufficient light has been shed on his occupational future. Today I am in charge of an institution in Brazil which is manned by a picked team of practising experts in psychiatry, occupational medicine, hygiene, education, statistics, social science and, last but not least, applied psychology. The results of our first inquiry into the effectiveness of our guidance activities are as favourable as those obtained in the course of twenty years' work in Catalonia. But in spite of everything it seems to me that we cannot yet pronounce ourselves satisfied, for the number of unsolved problems is greater than we had thought at the beginning of our work.

PROBLEM I

In the first place, how is one to solve the frequent problem of disparity between the results of tests for vocational inclination, which study the preferences and dislikes of the subject to be guided, and those of aptitude tests which indicate his likelihood of success in training and subsequent work? This dilemma was shown at its most dramatic when Alfred Adler, here in Paris, declared that to obtain happiness for a human being it was necessary to help him to overcome his weak points.

The main theme of his argument was that vocational advisers ought to guide those who consulted them towards some kind of work for which they had no aptitude, for in this way they would be helping to canalise the famous 'masculine protest'. The technical problem is as follows: to what extent can exceptional interest and extreme effort on the part of the individual compensate for and triumph over his lack of the required qualities of disposition or of innate aptitude? This is a difficult problem to solve, even when each case is carefully studied on its own merits. It seems to me that Adler's argument, in the form in which he has presented it, cannot be defended. The famous example of Demosthenes cannot be produced as evidence, for his handicap did not lie in the absence of an aptitude, but in a neurosis which affected the use of his oratorical powers. Certainly, however, anyone who so desires should be free to correct his faults by making use of situations and activities in which there is no risk of causing harm to other people.

If, however, we disregard the extreme form which Adler's argument took, there is still a dilemma which frequently perplexes the vocational adviser: should he encourage the subject to concentrate on what he likes best, or urge him to follow a career which will yield the best results eventually? In other words, he hesitates between offering immediate or ultimate satisfaction. Fortunately, in the majority of cases the aptitudes coincide with the vocational inclination, or, at least, are not far removed from it. It could even be maintained that an authentic sense of vocation ought to coincide with an adequate capacity, in view of the natural connection between the two in the 'structure' (constitution or substance); for 'power' and 'will', 'potentiality' and 'action', 'tension' and 'intention' are closely linked. Cases of apparent disparity between aptitudes and vocational inclination are therefore more often than not false cases, where the true disparity occurs between aptitudes and interests. Interests are more frequently governed by circumstances, and more easily influenced; they can occasionally spring from an attitude of opposition or reaction, as Adler has pointed out. The vocational adviser must therefore be able to detect, by means of a brief analysis, the emotional factors entering into the subject's inclination for some particular kind of work, and establish, if possible, the relative importance therein of the sense of vocation, interest and ambition, so as to forecast to what extent these motives can compensate for obstacles created by lack of ability. In the worst cases it is always possible to reduce the conflict by advising the subject to take up as a recreation or hobby the kind of activity he enjoys, and to undertake as his means of livelihood the occupation for which he seems 'marked out' by his aptitudes. It is even possible in some exceptional cases to act in the opposite way, and allow the subject to follow the career to which he feels most drawn, provided his aptitude is kept alive by the cultivation of a hobby. In other cases, moreover, we are able to find a mixed type of work, which embraces the two opposing tendencies (for example, that of Army medical officers, sanitary engineers, scenographers, impresarios, hospital analysts, architects, cinema technicians).

PROBLEM 2

Let us pass on to another problem, which is unfortunately more common and more difficult: the existence of incompatibility between the conditions created by the vocational inclination and by aptitudes on the one hand, and those of health on the other. The latter can be a source of danger, or constitute an obstacle in the way of attaining the forecasted success. It is not enough to ask the doctor to make a short- or long-term clinical prognosis. We must also forecast to what extent the fact of having to give up a career may actually impair the subject's health, which we are trying to preserve; in addition we must forecast whether or not the subject's disposition is such that he will be capable of observing the restrictions and the treatment which are advised. Let us take a concrete example: imagine a girl with suitable aptitudes and an urge to be a singer, who is at the same time found to have badly scarred lung patches of tubercular origin. Who can evaluate the innumerable unknown quantities on which may depend the happiness or unhappiness of that girl? These cases call not only for close collaboration between the doctor and the psychologist, but also for prolonged observation, reinforced periodically by medical examinations and psychiatric interviews; it is more likely that this girl's future may be determined in a few years' time by the chance event of a happy marriage rather than by all the efforts of the vocational advisers.

PROBLEM 3

And what of the cases where the opposition occurs 'outside' and not 'within' the subject? We have to think first of all of the difficulties which many an adolescent encounters in his own family; the latter has chosen his career in advance, while he desires to follow a different one. The vocational adviser knows that, if he upholds the judgment of the family, frustration will be set up which will remain with the subject for the rest of his life. But if, on the other hand, the adviser takes the part of the adolescent who is opposing his family, the result is merely, in many cases, to cause an even greater frustration. For even if, in the beginning, the parents appear to yield to the wishes of their son and the vocational adviser, a corrosive influence is henceforth at work; this in the long run will consume and destroy the boy's initial enthusiasm, by continually bringing him up against difficulties (economic, emotional, etc.), and will finally discourage him in his task, while denying him enjoyment in that which is now re-imposed on him.

To avoid this twofold danger, the vocational adviser cannot have recourse to statistics, for these, even if they can give us the illusion of exactness in measuring the value of an aptitude or the extent of knowledge of a subject, are incapable of measuring the degree of obstinacy with which those whose word is law in the family may cling to their opinions. In such cases the only possible approach is to have a series of interviews with the family and to estimate from these its likely reactions and behaviour in face of the various attitudes which the subject could adopt; on this basis the advice to be given must be so formulated that it will be conciliatory, flexible and practicable, whatever unforeseen changes may occur in the value of the variables. This is not a feat of mathematics but of diplomacy, and its success depends above all on the personal qualities of the adviser and his powers of persuasion.

PROBLEM 4

But there are some still greater problems which arise; what is one to do when there is agreement between the subject's desires, his family's aspirations, and his likelihood of success as indicated by suitable psychological aptitudes, but when, on the other hand, the medical report reveals a deficiency in physical stamina which constitutes a contra-indication in the case of the chosen work?

These cases seem easy when the vocational adviser confines himself to telling the subject the facts of the situation, indicating the pros and cons, and leaving it to him to decide whether to sacrifice a few years of life, or his pleasure in work. But often the subject asks: "What would you do in my place?" It is obvious, I think, that the adviser must decline the responsibility of replying directly to this question, but it is also clear that diplomatic evasions cannot satisfy the subject, and do not relieve him of the worry of indecision. In such cases it will be necessary for the adviser to summon the experts who evaluated the deficiency, and for these to explain to the subject from their first-hand knowledge of the question the pros and cons of his choice. Next, he will be asked to take time to think the matter over, and meanwhile the adviser will await his decision. If this proves to be quite unreasonable, a middle course can be indicated, that is to say, a way in which he can both take up the work of his choice, and yet preserve a satisfactory state of health. But if the subject seems fixed in his decision, it is wise to insist no further, for, after all, everyone has the right to dispose of his future as he thinks fit. What the subject requires from us is information and advice, not coercion.

PROBLEM 5

Let us now proceed to another problem which is often impossible to solve. The medical and psychotechnical examinations agree in estimating the physical and mental aptitudes to be adequate; the subject appears to be greatly attracted to his chosen occupation, and even the circumstances are favourable, but . . . personality tests indicate the existence of conflicts and complexes which, unless they are straightened out, are likely to lead sooner or later to a more or less serious crisis in his life. In such cases the subject must submit to a readjustment of character, by means of a thorough-going psychological analysis, to avoid an abrupt change in his emotional attitude towards his work, and even a subsequent deterioration of his aptitudes as a result of a regression in his personality.

The adviser is on the horns of a dilemma: either he runs the risk of needlessly alarming the subject, or he accepts the possibility of some future event taking place which will make his advice worthless. In such cases we advise the subject to enlarge the scope of his examinations so that he can receive 'life guidance' to complement his 'vocational guidance'. It is at this point, when giving the 'life guidance', that the adviser suggests a psychiatric consultation, which will naturally have to be carried out by competent specialists. It should be recognised how frequently it happens that subjects ask for an 'occupational adjustment' when in reality they need a 'life adjustment'; in this way the vocational guidance centres become something of the order of mental hygiene centres, more or less camouflaged, when dealing with a clientèle of adults or near-adults. Hence it is necessary for these guidance centres to be more closely integrated with organisations providing care and treatment than with those serving purely economic or industrial needs, or with institutions of an exclusively educational type.

When this method of approach is not adopted, the attempt at a diagnosis is very often fruitless, since it aims at revealing aptitudes rather than weaknesses, but in actual fact the subject's future is determined more by the correction of such weaknesses than by the use he makes of his aptitudes. There are two possible ways out of this *impasse*: the first was supported by Professor Toulouse at the previous Congress of Psychotechnics held in Paris, and consists of incorporating a psychiatrist in all vocational guidance services, and giving full weight to his judgment and advice. The second, which we believe to be the more effective, consists of postponing the drawing up of the vocational guidance report in the cases where emotional maladjustment, a situation of conflict or a psychopathic personality has been observed, until psychological or psychiatric treatment has brought about a stabilisation of the subject's emotional balance.

PROBLEM 6

And what shall I say of the immense problem which confronts the adviser when the subject lacks the necessary economic resources to devote himself to the course of study for which he seems best fitted, either by vocational inclination or by ability? What is to be done in these cases? From the technical point of view the problem can be evaded by saying: "That is no concern of mine", but from the human point of view one feels under a sense of obligation to do something more. Usually one directs the subject to philanthropic, cultural or charitable organisations which may provide bursaries, free places, opportunities for well-paid work, etc.; but unfortunately there is nearly always some obstacle—more often than not bureaucratic—in the way of obtaining the desired end. In such cases the adviser hesitates to compromise his personal reputation by undertaking to vouch for the subject, for he would then be obliged to take the responsibility for the latter's future conduct.

It is astonishing that a large number of the organisations devoted to assisting people with ability lack sufficient confidence in the results of psychotechnical examinations, and prefer to select at random, or through influence or by routine methods, the recipients of the financial help they offer for the vocational training of promising young people. Even in countries run on socialist lines, psychotechnical methods are given no greater prominence.

Nevertheless, in my view this fact must be attributed principally to the negligence of which we psychotechnicians have been guilty in our political, cultural and social relations. Consider the case of the doctors, the educationists, the economists and people of many other professions who have been able to make a place for themselves in the present social structure, where their services are employed and their decisions respected, because they have succeeded in spreading knowledge of and obtaining recognition for the scientific principles on which their work is based, and in putting before the public eye the results they have obtained. If they have been able to do this, there is no reason why the psychologists should not also acquire the same standing, by dissipating prejudice, ignorance or apathy wherever they are called upon to carry out their activities. We must create a Social Psychotechnics, parallel to Social Medicine and Social Education. Only then will our mission have reached the peak of its development.

PROBLEM 7

Finally, there is another problem to which I should like to draw your attention before hearing your comments which will, I am sure, be numerous and instructive. This concerns the difficulty of reconciling individual guidance and collective guidance; of finding, that is to say, a criterion for deciding whether to direct the subject to a task which will suit him most, or to one where his activity will be of the greatest benefit to the community. Lipmann said that in order to make technical and social progress we needed not only missionaries and pioneers, but also a certain number of exceptionally gifted people who were willing to work with reforming zeal in humbler circumstances than those to which their capabilities would have entitled them, but where they would eventually succeed in raising the standard of life through their example and their efforts. Thus, for example, Schweitzer benefited society by his individual sacrifice, and Madame Antipoff, who spent twenty years in isolation in the interior of Brazil, was able to lay the foundations of a new system of rural education by allowing her name to lapse temporarily from the international scientific scene. My question is as follows: how frequently and to what extent may and ought the adviser encourage certain exceptional people to undertake some task which is seemingly obscure, yet nevertheless necessary? By what criterion are we to decide whether to invite them to accept a humbler sphere of working life, a task that carries less remuneration and lower social prestige than those which they were easily capable of obtaining—and to offer them in exchange the uncertain compensation of interior ethical satisfaction, since they will not in all cases, either in their life-time or after their death, receive public recognition of their sacrifice?

In short, I have presented you with seven problems which, in my opinion, ought to receive our attention if we wish to reduce the strain of our professional responsibility. I hope that you will tell me if your understanding of the problems is the same as mine, and if you have better solutions to offer than those which I have attempted to indicate in the course of this brief personal contribution.

The Occupational Achievements of a Group of Blind Persons

By H. W. THIELE

Dr Thiele, who is a Lecturer in Psychology in the University of Queensland, summarises in this paper a thesis which, as a post graduate student at Birkbeck College, he presented for the degree of Ph.D. in the University of London.

A SHORT time ago, a Working Party on the Employment of Blind Persons (Ministry of Labour and National Service, 1951) published a Report which dealt comprehensively with the occupational implications of blindness and with the provision made in this country for the education, rehabilitation, training, placement and employment of the blind. The Working Party, besides recording recent advances in these fields, put forward suggestions for future action to aid the efficient employment of the blind, including research into their occupational potentialities.

The research here described was undertaken with two aims. The first was to obtain information that might be of use in the extension of the range of employment available to blind persons of superior education. The second was to ascertain what characteristics, if any, distinguish persons who, having been blind from early years and having had education of a superior type, have done particularly well occupationally.

OCCUPATIONAL POTENTIALITIES OF THE ABLE BLIND

A number of methods of investigation are feasible or have been used in the past in pursuit of such aims as the first. The method used in this case was systematically to collect information concerning the occupations which numbers of blind persons of superior education have succeeded in following, and to make more detailed studies of any part of their occupational histories which showed enlargements of the accepted range of occupations for the blind.

After preliminary discussions and correspondence with officials of the National Institute for the Blind and other administrators of blind welfare, with other persons in responsible positions concerned with the care of the blind (including officers of the Ministry of Labour and National Service), and with interested psychologists, it was decided to send a questionnaire to each of a number of persons who, between 1932 and 1942 inclusively, completed their schooling at a grammar school for blind girls, a grammar school for boys, and a blind school which was in effect a technical college and academy of music for both sexes. (The last functioned in part as a grammar school as well, until the late 'thirties.) These are the only schools of their types in England and Wales.

The questionnaire used (see Appendix) was designed to obtain information about the education, vocational training and employment of as many as possible of the persons concerned, and their opinions about their training and employment, as well as about the employment of blind persons in general. The questionnaire survey was intended to be as close to a complete census of the chosen group as circumstances would permit.

A number of reasons existed for choosing 1932–1942 inclusively as the period covering the conclusion of the secondary schooling of the persons concerned. Most of the persons concerned had, by 1953, had sufficient time to become settled vocationally, if necessary after having tried more than one occupation. There had also been sufficient time for the formation by some of opinions of value concerning their training and employment. The period which had elapsed between 1942 and the commencement of the investigation was sufficiently long to enable one to avoid some of the dangers involved in generalising after follow-up studies made when the subjects of the study have been employed in their chosen vocations for only a short time. Again, the period chosen was sufficiently recent for the social, economic and technological background of the school groups to be somewhat similar to the corresponding background at the present time. Finally, the period was sufficiently long for a number of hundreds of people to be included in the group studied.

Not all the names on the school records for the period 1932–1942 could reasonably be taken for reference in mailing questionnaires. Those omitted from the list were of persons who were known (a) to have withdrawn from their schools in order to complete their education at schools for the sighted, as sighted pupils; (b) to have been withdrawn from school at the request of the Principal, in some cases as being of an intelligence below the minimum standard required to justify attendance at the school concerned; (c) to be at present living elsewhere than in England and Wales; (d) to be in mental homes; or (e) to be dead.

Inquiries had shown that at least three educationally blind persons of intelligence and training comparable with those of the members of the groups mentioned above were educated elsewhere than at these schools for the blind and concluded their schooling during the period 1932–1942. The three persons contacted were included in the group surveyed.

The approach to the blind persons concerned in the study involved sending, by post, copies of:

(i) An introductory letter from an authority of the relevant school asking for co-operation in the research.

(ii) The questionnaire and an accompanying letter, both in braille.

(iii) The questionnaire in large ink-print and an accompanying letter, to those who after approximately five weeks had not replied to the first request for information.

(iv) A third letter to those who approximately four weeks later had not replied to either of the foregoing requests.

(v) A final short note to those who, six months after the making of the first request, had not replied to any request.

(vi) A short letter to each person who replied to the questionnaire, acknowledging receipt of the reply and thanking the sender.

It was thought that sending the questionnaire in both braille and ink-print would satisfy the conditions necessary for all of the persons approached to understand the missive, for it was expected that a small percentage of those concerned in the study would, due to improvements in their vision or to some other cause, have ceased to use braille for reading and writing. (Not all those who for purposes of education and employment are regarded as 'blind' entirely lack the power to see. For educational purposes blind pupils are those "who have no sight or whose sight is or is likely to become so defective that they require education by methods not involving the use of sight" (Ministry of Education, 1945). Under the terms of the Blind Persons Acts (1920, 1938) a blind person is one "so blind as to be unable to perform any work for which eyesight is essential".)

The second and subsequent appeals would, it was hoped, by securing more replies to the questionnaire, help to reduce any systematic differences between the characteristics of the group who replied to the appeal and the characteristics of the remainder of the group. Postal questionnaires have been shown in the past to be susceptible to the production of biased samples, because of their incomplete return (Yates, 1949).

THE RESPONSE TO THE QUESTIONNAIRE

Table 1 shows the response to the appeal for answers to the questionnaire. Statistical treatment of replies to the questionnaire was based on the replies of 219 persons, from a total eligible group numbering 299. The census was, in the terminology suggested by Yates, incomplete. Very desirable though it may have been to have endeavoured to obtain answers to the questionnaire by visiting those who did not reply, this was not done, since it would have consumed an inordinate amount of time and money in comparison with what was devoted to the main body of the work, but without any guarantee of one's obtaining more answers to the questionnaire. The percentage of replies received compares favourably with the percentages received in follow-up studies of vocationally guided cases (Stott, 1952), in situations not very different in their essentials from the present one.

Though the group responding was not entirely representative of those who possibly might have replied, it was the best approximation to a representative group that this survey could obtain. If in later portions of this report reference is made to this group as representative of blind grammar and technical-school leavers in general, or of such school-leavers for the period 1932-1942, it will be with the implied qualification that the representation is not perfect. Some indication as to whether those persons who did not reply to the questionnaire were likely to be in some way different from those who did may be gained from a study of the types of prevocational training originally received by the 219 persons who replied to the questionnaire and the 62 who, presumably having received requests, did not reply or else declined to reply. The persons approached had received occupational preparation of five broad types. One group, G, received a general education only, not resulting in the passing of a School Certificat

TABLE I: RESPONSE TO THE APPEAL FOR ANSWERS TO THE QUESTIONNAIRE

Number of persons originally listed to receive questionnaire	319
Number of persons replying to questionnaire	219
Number of persons declining to reply	11
Number untraced	16
Number presumed to have received questionnaire, but not replying ..	51
Number found to have been ineligible for inclusion in the group surveyed (dead, living abroad, etc.)	22
Percentage of those originally listed who provided usable replies	68.7
Percentage co-operating of those actually eligible for inclusion in the group surveyed.	73.7

or higher examination. Another group, M, was trained in musicianship and/or piano tuning. Another, P, was trained in physiotherapy. The members of another group, N, were prepared for other professions than physiotherapy. Group S received training in shorthand-typing and/or telephony; and a final, small group, O, received miscellaneous forms of training. The overall differences between the proportions replying to the questionnaires in the first five of these groups were significant at the .01 level. The groups arranged in descending order with respect to the proportion of non-reply were M, S, N, G and P. Again, when the differences in the proportion of those from grammar schools and from the technical schools were compared, they were significant at the .01 level, with greater proportions replying from the grammar schools (most of the persons in group M were trained at the technical school and academy of music). There was no significant difference between the proportions of males and females replying.

THE ENLARGEMENT OF THE RANGE OF EMPLOYMENT OF THE BLIND

The occupations of those replying to the questionnaire comprised (briefly) braille shorthand and typing; physiotherapy, piano-tuning, music teaching and performing, legal practice, braille copying and proof reading, telephony, lecturing and teaching, welfare work, housekeeping, secretarial work, junior executive work, manual work (including farming), the Christian ministry, factory work, administrative-higher executive work, retailing, and journalism and other writing. (The occupations are set down in descending order of frequency.)

Certain of the occupations within these groupings appeared important from the point of view of the enlargement of the range of occupations customarily acknowledged to be available to the able blind. This was confirmed in discussion with persons in responsible positions concerned with the education and employment of the blind. The importance of some of these occupations was apparent, too, in the light of a statement in the Report of the Working Party on the Employment of Blind Persons: "There have been many . . . examples of blind persons who have brought to public and other appointments first-class organizing ability, great intellect, and energy. As might be expected, blind welfare has proved a fertile field for the exercise of their gifts. But it would seem that, even within blind welfare, with a very few exceptions, the opportunity of full-time remunerative employment for blind persons on administrative or executive work has been confined to the larger national bodies." Job studies were made of the occupations returned in this survey which were regarded as of special importance. For this purpose, the Revised Job Study Schedule (Form VGC/JS2) prepared at the Vocational Guidance Centre at Birkbeck College, London, was used. The persons whose work was studied in this way included a female secretary shorthand-typist in a business organisation; a male committee clerk working for the Corporation of a provincial city; a male confidential secretary and shorthand-typist; and a male progress clerk in a business organisation. These four persons all possessed sufficient vision to be able to read print though not without difficulty, and perhaps not for extended periods. All claimed to be registered as blind persons.

Studies were also made of the work of: a clerk-typist in a local government office; a placement officer and organiser of an occupation centre in an institution for the blind; and a minutes secretary in a business organisation.

These job-studies verified what the replies to the questionnaire had demonstrated, namely, that a number of registered blind persons have proved themselves able to obtain and hold positions of executive or near-executive grade, some of these positions spanning the gap which has been recognised to exist between the position of shorthand-typist and that of the administrator, into which position it is recognised that very capable blind people sometimes make their way.

The job-studies did not demonstrate the ability of all blind persons of good education—nor even of all blind shorthand-typists—to hold positions of these kinds. On the contrary, they indicated some special qualities which appeared to be required in blind persons in the occupations concerned, and without which it would not have been possible for them to hold their positions. From the replies to the questionnaire, information was also available concerning positions which had been held in the past by persons concerned in the study. Of these positions, the one which had 'broken new ground' was that of a wartime monitor of foreign language broadcasts received in England. A description of the essentials of this position was composed.

One questionnaire reply had been received from a totally blind man who claimed to be a smallholder and to be working virtually independently of sighted assistance. The opinion is expressed in the Report of the Working Party on the Employment of Blind Persons that "The ability of exceptionally determined and competent blind persons to overcome their handicap is such that it would be rash to rule any occupation wholly out of consideration, but we suspect that blind men returned as occupied in one-man rural occupations have some degree of sight, as well as the indispensable qualification of aptitude and experience". In view of this statement, it was desirable to study this person's position more closely. It was found that the person concerned, who was indeed showing great determination in building up a small holding taken over two years beforehand, had not then reached a stage where he was self-supporting. His work was, however, being done with virtually no sighted assistance. From the evidence of the job-study, it was not possible to give a decisive answer to the question whether or not a holding providing sufficient income to support at least one person can be managed by a totally blind person without assistance.

THE ACCOMPANIMENTS OF OCCUPATIONAL ACHIEVEMENT

A number of considerations made it advisable to use the interview as a research instrument in the attempt to fulfil the second aim of the research, that of suggesting reasons for the degrees of occupational achievement of persons who, while blind from early years, have had grammar- or technical-school education. Not least among these was the acceptability of the interview to those whose co-operation was being sought in the research.

With the aid of a table of random numbers a sample group of 81 persons was chosen from the first 198 respondents to the questionnaire. Each occupational category was sampled separately, two-fifths of its members being chosen.

To the 81 persons whose names were selected, letters were sent requesting interviews. A letter of reminder was sent to those who had not replied to the request after a little more than a fortnight. Four of the persons approached replied that they were unwilling to be interviewed, and six did not reply to either of the requests for interviews. Replacements for these ten persons were therefore chosen from the appropriate occupational categories using the above-mentioned method of random selection. Requests for interviews were sent to the persons so chosen, with letters of reminder sent later, where necessary. Two persons in the 'replacement' group replied that they were unwilling to be interviewed. Their replies arrived too late for more persons to be approached as replacements. The ultimate size of the group interviewed was 78, as one of the intended interviews did not eventuate.

The sample as it was constituted at this stage was no longer exactly representative of the parent population. The dissimilarity was perhaps reduced by the choice of replacements from the same occupational groups as those of the persons who did not agree to have interviews. The numbers

RESULTS: ASSESSMENTS BY THE JUDGING PANEL AND THE INTERVIEWER

The suggestions for assessing the questionnaire replies which had been made to the members of the judging panel allowed for some variation in the numbers of replies occurring in each of the five categories. Two of the judges used the numbers 8, 16, 31, 16 and 8 in the different classes. One judge found it more satisfactory to place 8 replies in the uppermost grade, and 24, 34, 8 and 3 in the other grades from B to E, excluding from consideration two of the replies which had been received from people who now work as seeing persons. Another judge placed 10 replies in group A, 15 in B, 30 in C, 15 in D, and 9 in E. In order to average the ratings made by the four judges for each member of the group studied, the gradings given by each judge were converted to normalised standard scores. These were then added, to give final scores which could be rank-ordered. One person's score was dropped from calculations at this stage. This was the person in whose case it had appeared that an interview would be possible but did not eventuate. The remaining 78 scores were then re-grouped into five grades in an approximation to a normal distribution. For this purpose, the numbers normally required in each of the groups would have been 5 in A, 19 in B, 30 in C, 19 in D, and 5 in E. The actual numbers placed in the groups were, ranging from the uppermost group, 5, 19, 32, 16, and 6. These groupings were made desirable by the presence of ties in the rank-order.

During the statistical calculations whenever tetrachoric correlation coefficients were calculated from these data, the cutting point was always taken between Groups B and C. Thus, groups A and B were placed together to form an 'outstanding' group, and groups C, D and E formed the other portion of the dichotomy. This procedure was adopted uniformly in order to avoid errors due to 'capitalization or decapitalization on chance' (McNemar, 1949).

When the data were used for calculation of χ^2, 3 × 3 tables were used wherever possible, the three groups for each variable being (i) sub-groups A and B; (ii) sub-group C; and (iii) sub-groups D and E. This reduction of five groups to three was necessary in order to ensure a minimal expected frequency of 5 for each cell of the χ^2 tables. In a few cases, it was necessary to reduce the sizes of the χ^2 tables even more.

THE SELF-CONSISTENCY OF THE CRITERION

The degree of internal consistency of the criterion is shown in Table 2. The correlation coefficients shown are tetrachoric, and the levels of confidence are shown in subscript.

The sizes of the coefficients of correlation in Table 2 indicate that there was a good deal of agreement among the judges as to which members of the group studied were outstanding and which were not. The fact that the intercorrelations were not nearer unity indicates that four slightly different points of view were being brought to bear on the assessment of the members of the group — a fact which, in view of the judges' experience, can be

TABLE 2: INTERRELATIONS OF JUDGES' ASSESSMENTS

JUDGES	B	C	D
A ..	+.76 (.001)	+.72 (.001)	+.60 (.01)
B ..		+.56 (.01)	+.62 (.001)
C ..			+.48 (.02)

expected to increase the value of the composite grading obtained by combining their assessments.

After the investigator had concluded his interviewing, he reviewed each of the relevant 78 questionnaire replies and the corresponding interview forms. He re-rated certain of the characteristics he had assessed before—without reference to the first ratings—and at the same time made his own assessments of the occupational achievements of the members of the group, placing 8 in Grade A, 16 in B, 30 in C, 16 in D, and 8 in E.

Though the investigator's experience of the blind had not been as extensive as that of the judging panel, his assessments were aided by the excess of the information at his disposal as a result of the interviews, over that which could be obtained from the questionnaires. The intercorrelations between his assessments and those of the judges are shown in Table 3.

TABLE 3: COMPARISON OF ASSESSMENTS MADE BY JUDGES AND INTERVIEWER

Comparison of investigator's assessment with that made by:	r_{tet}	Level of Significance
Judge A	+.73	.001
Judge B	+.66	.001
Judge C	+.77	.001
Judge D	+.52	.01
Composite of judges' assessments	+.69	.001

The intercorrelations here seem sufficiently high to help to justify the use of the questionnaire as a basis of assessment, and also the use of the composite rating by the judges as a criterion.

The re-rating of some of the qualities assessed during interviews had been undertaken to provide some check, however slight, on the consistency of the rating. Table 4 shows the tetrachoric correlation coefficients between the first and second ratings of the traits concerning which there was sufficient written evidence obtainable from the interview forms and questionnaire replies to make re-rating with the aid of memory and the recorded information seem feasible.

All the ratings had been made on a five-point scale. Any re-rating was separated from its corresponding first rating by a period which varied from just under one week to approximately three months. All coefficients are significant, P in all cases being less than .001.

TABLE 4: CORRELATIONS BETWEEN ORIGINAL AND SECOND RATINGS

TRAIT RATED	CONSISTENCY COEFFICIENT	TRAIT RATED	CONSISTENCY COEFFICIENT
Mobility	+.93	Satisfaction with work	+.84
Success at school	+.94	Interests shown during schooldays:	
Intelligence	+.96		
Verbal ability	+.88	Intellectual	+.90
Acceptability to others	+.89	Practical-constructional	+.80
Influence on others	+.91	Social	+.84
Dependability	+.77	Artistic	+.83
Self-reliance	+.64	Physically-active	+.92
Economic status of early home background	+.95	Average of interests	+.76

From these coefficients it can be seen that the subjective judgment of the investigator concerning these traits in the interviewees was at least reasonably consistent. But to demonstrate consistency in ratings is not to demonstrate validity or relevance. The plan of the research did not lend itself to a comprehensive study of this aspect of the ratings. The main evidence which can be adduced to give indirect support to any suggestion as to the validity of the ratings is in the systematic planning of the interviews.

CONCOMITANTS OF OCCUPATIONAL ACHIEVEMENT

Table 5 summarises the relationships between the variables obtained from interviews and the composite rating by the judges of the occupational achievements of the group interviewed.

For each variable, the general procedure in compiling this table was by means of a χ^2 test to find whether a relationship existed between the variable and the criterion. If this test showed a significant relationship, the size of the relationship was estimated by calculating a contingency coefficient. The number of cases for each variable was (unless otherwise stated) 78.

Due to the requirements concerning minimal numbers which may appear in the table of expected frequencies during the calculation of χ^2 and consequently of the contingency coefficient (C), adjoining categories in the tables

TABLE 5: RESULTS OF TESTS OF ASSOCIATION BETWEEN INTERVIEW VARIABLES AND CRITERION OF OCCUPATIONAL ACHIEVEMENT

VARIABLE	χ^2 P	C	EXTENT OF CONTINGENCY TABLE	r_{TET}
A: RATINGS ON A 5-POINT SCALE:				
1. How striking in appearance (neatness, cleanliness)	.05	.299	3 × 2	+.15
2. How striking in appearance (facial)	.10			
3. How striking in bearing (N=77)	.05	.338	3 × 3	+.22
4. How striking in speech	.10			
5. How skilled in mobility	.50			
6. How successful in school	.01	.409	3 × 3	+.57
7. How intelligent	.001	.524	3 × 3	+.56
8. Extent of verbal ability	.001	.487	3 × 2	+.40
9. How confident during interview	.10			
10. How acceptable to others	.001	.575	3 × 3	+.68
11. How far influencing others	.001	.543	3 × 2	+.57
12. How steady and dependable	.001	.400	3 × 2	+.55
13. How self-reliant	.01	.382	3 × 2	+.46
Participation during schooldays in activities indicative of interests which were:				
14. Intellectual	.02	.378	3 × 3	+.49
15. Practical-constructional	.50			
16. Social	.001	.504	3 × 3	+.45
17. Artistic	.001	.498	3 × 2	+.22
18. Physically-active	.20			
19. Average strength of interests	.001	.543	3 × 3	+.48
20. Functional value of sight at present	.20			
21. Functional value of sight while at school	.50			
22. Economic status of early home background	.50			
23. Extent to which braille is used in present work	.05	.305	3 × 2	−.08
24. Present proficiency at braille	.20			
25. Age at which braille was learnt (Age 4 to 6; 7 to 9; 10 to 12; 13 to 15; from 16 on)	.10			
26. Satisfaction with present work	.05	.291	3 × 2	+.26
27. Age when final vocational decision was made (to age 11; 12 to 14; 15 to 17; 18 to 20; 21 on). (N=77)	.10			
28. Age on entering residential school (to age 3; 4 to 7; 8 to 11; 12 to 15; 16 to 19; 20 on)	.70			
B: VARIABLES FOR WHICH 5-POINT SCALES WERE NOT USED:				
29. Presence *v.* absence of mannerisms (including repetitive movements to aid vision)	.20			
30. Presence *v.* absence of mannerisms (excluding repetitive movements to aid vision)	.50			
31. Presence *v.* absence of undesirable personality traits	*			
32. Lost vision before 4th birthday *v.* after	.99			
33. Educated at "technical" school *v.* educated elsewhere	.10			
34. Sex	.20			
35. Reported difficulty in securing admission to school *v.* no such report	*			

VARIABLE	χ^2 P	C	EXTENT OF CONTINGENCY TABLE	r_{TET}
36. Received financial assistance (e.g. from local Education Committee) while at school *v.* did not receive such assistance	*			
37. Primary vocational decision made by self (+ direction) *v.* by others...	.01	.336	3 × 2	+.49
38. Opposition to vocational decision (by self, or by parents or teachers) *v.* no opposition	*			
39. Obtained promise of employment before end of latest course of training *v.* obtained no such promise	.90			
40. Took course of study or other training while working *v.* did not	.90			
41. "Only" child *v.* member of sibling group	.50			
42. Health while at school (reported as Good, Average, or Below Average)	.20			
43. Health since schooldays (reported as Good, Average or Below Average)	.10			
44. Reported nervous troubles during schooldays or later *v.* no nervous troubles reported	.20			
45. Evidence of parental over-solicitude *v.* no evidence of this	.50			
46. Favourable home background (+ve direction) *v.* general unfavourable background (rejection, over-solicitude, broken home)	.05	.268	3 × 2	+.37
47. Evidence of major domestic worries during working life *v.* no such evidence	*			
48. Time spent in training after age 15 (8 or more years, +ve direction *v.* fewer than 8)	.01	.325	3 × 2	+.29
49. Received some education in school for the sighted *v.* did not	.50			
50. Had blind siblings *v.* did not	*			
51. Amount of unemployment (Employed 4/5ths of working life *v.* not employed 4/5ths of working life)	*			
52. Self-employed *v.* other-employed	.70			
53. Married *v.* single	.50			
54. Age when married (Before age 27 *v.* after) (N=42)	.99			
55. If married, has children *v.* has none. (N=42)	.99			
56. If married, has wife or husband who helps appreciably with work or is employed independently *v.* has not. (N=42)	.90			

* It was not possible to apply the χ^2 test to these items due to fewness of cases in one or more categories.

used had sometimes to be combined and the sizes of tables reduced. For this reason, though the tables considered were primarily 3 × 3 tables, they sometimes have been reduced to 3 × 2 or even 2 × 2. For a 2 × 2 table, the upper limit of C is .742. For a 3 × 3 table, it is .816. The exact upper limits for rectangular tables are unknown (McNemar, 1949).

Where contingency coefficients are shown in Table 5, so too are tetrachoric correlation coefficients calculated from the same data. These are shown merely because this coefficient is perhaps more widely used and to some more meaningful than the contingency coefficient. But since the distributions of ratings of some of the traits here studied are not normal, r_{tet} cannot be used in these cases without recognition of the fact that it implies a normalising of the distributions concerned. The contingency coefficient is free of this assumption.

From Table 5 it can be seen that of the variables related to occupational achievement among the members of this group, ratings of the social qualities of acceptability to others and ability to influence others appear important, as also, though to a lesser degree, do ratings of two indicators of self-discipline, namely, steadiness and dependability and self-reliance.

The level and quality of the school attainment of the persons concerned, their intelligence, and their verbal ability as rated during interview (but not mere pleasantness of voice) were related to achievement. If these factors have in the past been used as indicators of the probable level of achievement of blind technical-school pupils, then their use has probably been justifiable. The same holds, too, for the physical attributes of bearing (but not of skill in mobility) and of neatness and cleanliness of appearance. The average depth of the interests the group's members reported having had during their schooldays was related to their achievement, and in particular, having had interests of an intellectual, a social, or an artistic type, (but not of a practical-constructional or a physically-active type) was associated with it. (Many of the occupations of the members of the group studied called for intellectual, social or artistic *activities*.)

Those who had done well tended to be those who had themselves decided upon their careers, rather than those who left this decision to parents or teachers; but the age at which the decision was made was not a predictor of extent of achievement.

The general normality of the home background, but not its economic level, was another factor which appeared to be associated with high achievement. So, too, was the number of years of education received. The last-stated fact is perhaps evidence for the value of any educational and vocational guidance received by members of the group.

Those who were assessed most highly for achievement tended to be the most satisfied with their work. This perhaps indicates a tendency on the part of the members of such groups to a realistic appreciation of the advantages and disadvantages of their occupations. A slight negative relationship existed between the extent to which braille is used at present, and achievement. There were no relationships between proficiency at braille and the age when it was first learnt, and achievement.

Among the other factors which were shown not to be related to occupational achievement were ratings of attractiveness of facial appearance and of the extent of the social confidence shown during interviews. The presence of repetitive mannerisms was unrelated to level of achievement.

Having suffered 'nervous' troubles in childhood or adolescence was unconnected with achievement or lack of it. Neither having been an 'only' child nor having been a recipient of parental over-solicitude was in any way related to achievement. Nor were the age at which vision was lost or first noticed to be absent and the age of first attendance at a residential school. Having had some schooling at schools for seeing children was also unrelated to achievement. So, too, were the obtaining of promises of employment before the end of training courses, and the taking of courses of study while working.

Those who were self-employed were not necessarily higher achievers than those who worked for others. Marital status, the age at which marriage took place, the presence or absence of children in a marriage, and the amount of occupational assistance given by a spouse — all these bore no relationship to achievement.

No significant relationship was found between the degrees of any sight possessed by the members of the group and their achievements, nor between sex and achievement. There was also no relationship between achievement and interviewees' statements concerning their health. These are indicative of the value of the assessing of the questionnaire replies done by the judging panel, since it had been suggested to the judges that these factors should be taken into account when assessments were being made.

CONCLUSIONS

The general survey and the job-studies undertaken in this research have indicated ways in which the range of employment of the blind might be expanded.

The able blind person too often finds himself in such a position that he must choose the type of occupation he will follow from no more than four or five possibilities. Though the training he will receive for his occupation is usually very good, an unfortunate choice of occupation can cause much unhappiness, and re-training may prove a lengthy and costly process.

Some hopes for expansion of the range of employment of blind persons of superior education seem to lie in the employment of suitable blind persons in occupations of a secretarial type, at a level higher than that of the shorthand-typist. Employers may at first feel loth to provide sighted clerical assistance for such a person for an hour or so per day, but it has in the past been shown possible for a minor exchange of duties between a blind and a sighted employee to result in an entirely satisfactory state of affairs for employer and employees alike.

There are indications, too, that it would probably be worth while to carry out further research into the employment of trained blind persons in clerical positions. With this might be combined a supplementary course of training, or special adaptations to some already existing course of training (for example, in shorthand-typing), to prepare selected blind persons for such positions.

The results of the enquiries concerning variables associated with high achievement among the members of the group studied may, especially if steps are taken to employ blind persons tentatively in new occupations, be of assistance to those concerned with the vocational guidance of young blind people, and to the blind themselves.

ACKNOWLEDGMENTS

The writer gratefully acknowledges the action of the University of London and the National Institute for the Blind in making grants to cover expenses incurred in this research, and the co-operation of many other persons whose kindness made the research a possibility.

APPENDIX

QUESTIONS ON TRAINING AND EMPLOYMENT

When making your replies, will you please give first your name and address, and number the answers as the questions are numbered?

1. How are you employed at present (or in the last work you did if you are not working now)?
2. What exactly do you do in your work?
3. In what ways (if at all) do you use help from sighted people in it?
4. Is your work whole-time or part-time?
5. How long have you had it?
6. How did you get it?
7. What training, if any, did you have for it? If you took any definite training courses, when and where did you take them, how long did they last, and were they full-time or part-time?
8. Did your training courses (if any) lead to any certificates, diplomas or degrees? If so, please give the names and dates of the examinations, and the results you obtained.
9. What other work have you done whole-time or part-time since you left school? Please say how long you held each of your positions, however short the period was; and include different positions you may have held in the same organisation.
10. Please list all your absences from work which have lasted at least two months, giving their durations and causes.
11. Please give the name and date of any School Certificate or Higher School Certificate you have obtained.
12. Please say, in as much detail as you can remember, the subjects you took in any such Certificate examinations and the results you obtained in each subject.
13. If you have taken any other examination not covered by Questions 8, 11 and 12, please say what they were and when you took them, and give the results in as much detail as you can remember.
14. Have you ever been registered as a blind, partially sighted, or disabled person? If so, when, and under what Act or Acts?
15. If you have any sight, in what ways have you used it in your work?

Questions 16 to 20 refer to your present work. If you are not working now, please take them to refer to the occupation you liked best, and indicate what that was.

16. Are you on the whole satisfied with your work? Please give reasons for your answer.
17. What aspects of it do you find most difficult? And which do you find easiest?

18. How do you think the difficulties for a blind person could be eliminated or reduced?
19. Have you yourself been able to overcome any of the difficulties? If so, how?
20. Taking account of all the personal experience you have gained, how would you now advise a blind friend about methods of entering your occupation?
21. Finally, have you any additional comments you would like to make about any of your training and employment, or about the training and employment in general of people with little or no vision?

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Book Reviews

The Psychology of Adolescence: Behaviour and Development. By JOHN E. HORROCKS. London: Harrap, 1951. Pp. xviii + 614. Price 30*s.*

Dr Horrocks's expressed aim in this book is to furnish students and workers with young men and women with an objective picture of adolescence. He states that the book is " based upon a selected survey and interpretation of the literature of adolescence from the point of view of a psychologist and an educator. Facts are presented together with a discussion of their implication in the daily life of an adolescent ".

Dr Horrocks arrives at the view that, in Western culture, there are five points of reference from which to view adolescent growth and development. He sees adolescence (a) as a time of seeking status as an individual, (b) as a time when group relations become of major importance, (c) as a time of physical development and growth, (d) as a time of intellectual expansion, development and academic experience, and (e) as a time of development and evaluation of values. The book follows the pattern of setting out in considerable detail what has been explored and discovered about adolescents under these five headings from empirical and experimental, but mainly American, studies.

In conception, and in the broad headings under which adolescence is studied, this book is good. I have little doubt that most of the American work of value in this field has been included, and very occasional reference is made to European and South American published material. One would be pardoned in thinking, after reading this work, however, that, outside the USA, hardly anything of significance in this important field had been published. Since the author has concerned himself almost entirely with the United States culture, although sometimes with the explicit assumption that what is said is true of the Anglo-American culture, a good deal of the material on the social psychology of adolescence, and on interests and media of communication, is of doubtful validity for British adolescents.

The main criticisms of the book arise as a result of its methodological approach. From the text, it is often difficult for the reader to perceive clearly what has been positively established and what is still speculative. This occurs because Dr Horrocks, despite his selective survey, has not been able to assemble together information on particular aspects of adolescence of similar standards of objectivity and validity. Some of the conclusions in the original studies have been based on small numbers or on selected samples, while many of the 'facts' have been culled from questionnaire and inventory surveys, of varying degrees of sophistication. In places, although the evidence may be extremely scanty, or that obtained from one source may be at marked variance with that obtained from another, there is still discussion of such information as has been gathered.

Secondly, as a normative survey based largely on quantitative methods, the book fails in many places to give that deeper insight into adolescent feelings and motivation that qualitative methods might be expected to give. Dr Horrocks has attempted to meet this shortcoming by including at the end a condensed chapter on " The Bases and Outcomes of Adolescent Behaviour ", followed by a case study.

The extremely extensive references and bibliography leave little doubt of the labour that has gone into the compilation of the work. It undoubtedly includes a wealth of information. Even if much of it serves to confirm the beliefs, based on common sense, or acquired in the course of actual practice, of experienced workers in this field, it is comforting to have this confirmation. The newcomer to work with young men and women is likely to derive most value from reading the early chapters, which are on the social psychology of adolescence. He may be struck, however, by the comparatively few references to delinquency and crime.

This book is likely to be of greatest value as a central source of reference to studies which have been undertaken in the United States into most aspects of adolescence. It may be of more limited value in the understanding and advising of British adolescents. It is well served with tables and graphic figures from the original studies, although one could wish that some of these had been less concisely labelled. The summaries at the end of each chapter are excellent, setting out the conclusions in a concise and easily accessible form. These will be of real value to the busy reader who may want to know the main points made and only delve more deeply into those aspects of particular interest to him.

BRET HARDING

The Selection of University Students. By F. W. WARBURTON. Publications of the University of Manchester School of Education, Number One. Manchester University Press, 1952. Pp. viii + 46. Price 4*s*. 6*d*.

Reporting Research in Education. By STEPHEN WISEMAN. Publications of the University of Manchester School of Education, Number Two. Manchester University Press, 1952. Pp. viii + 23. Price 3*s*. 6*d*.

In the first paper of this series Dr Warburton gives an admirably clear non-technical account of the problems involved in the selection of university students and a survey of research work on the subject done and still going on in Great Britain, including some investigations in several departments of Manchester University which do not appear to have been published. The criteria of university success are discussed, present methods of selection, such as external school examinations, confidential school reports and personal interviews are in turn examined, and further methods which might be useful are considered. Dr Warburton concludes that the result of the final degree examination is the safest criterion against which to validate selection techniques and holds that present day methods, though reasonably effective with the best and weakest candidates, are capable of much improvement. At the borderline especially where a decision is, of course, always difficult he believes that both psychological tests (including verbal and non-verbal types which would have to be specially devised to discriminate at high levels of ability) and group interviews somewhat on the lines of WOSB and CSSB procedures are likely to be of considerable value. He recommends that follow-up enquiries of the predictive value of these and the more conventional methods should be carried out separately for the different university departments. A useful bibliography sensibly distinguishes between British work in this field and that carried out in the USA where conditions are very different.

Dr Warburton quotes from the *Universities Quarterly* that 'the methods of selecting students are indeed very unsatisfactory and the universities themselves admit it'. It is to be hoped that the universities, which are indeed far from complacent about the present situation but seem to look askance at psychological selection methods, will afford more facilities for some large-scale investigations of methods which might very well lead to an improvement in the quality of students as well as a worthwhile reduction in wastage rates.

Dr Wiseman's booklet deals with reporting research on an experimental topic. The first part is concerned with the preparation and writing of a thesis and is adapted from a memorandum prepared for the guidance of higher degree students in the Manchester Department of Education. It was worth making it more widely available, for it includes not only much useful general advice on the construction of a thesis, on the setting out of aims, methods and results, but also detailed suggestions about figures, tables, bibliography and so on. The second part is a brief guide to the preparation of a paper for publication in a journal. Dr Wiseman writes concisely and clearly and what he has to say should prove very helpful to research students, to whom the booklet may be warmly recommended.

A. H. D. TOZER

Other Books Received

The following books have been received. Their inclusion in this list does not preclude their review later.

Symposium on Fatigue. Edited by W. F. FLOYD and A. T. WELFORD. London: H. K. Lewis (for the Ergonomics Research Society), 1953. Pp. viii + 196. Price 24*s*.

The Conception of Disease: its history, its versions and its nature. By WALTHER RIESE. New York: Philosophical Library, 1953. Pp. viii + 120. Price $3.75.

Outline of Executive Development. By L. STOCKFORD. Pasadena: California Institute of Technology, 1953. Pp. vi + 46. Price $2.00.

Recruiting the College Graduate. By R. S. UHRBROCK. New York: American Management Association, 1953. Pp. 32. Price $1.25.

Personnel Salaries and Ratios: 1953. By D. YODER and L. N. WILSON. Minneapolis: University of Minnesota, 1953. Pp. 10. Price not stated.

Recognition of Individuals. Pasadena: California Institute of Technology, 1953. Pp. 30. Price not stated.

Orientation et sélection professionnelles par l'examen psychologique du caractère. By FRANZISKA BAUMGARTEN. Paris: Dunod, 2nd edition, 1954. Pp. viii + 192. Price 750 French francs.

Introduction to General Psychology. By E. J. ASHER, J. TIFFIN and F. B. KNIGHT. London: Harrap, 1953. Pp. xvi + 516. Price 25*s*.

Projective Drawings. By CLAIRE MYERS VERNIER. New York: Grune & Stratton, 1952. Pp. viii + 168. Price not stated.

Making Personnel Practices and Programs pay off. AMA Personnel Series No. 151. New York: American Management Association. Pp. 64. Price $1.25.

Vocational Aspect of Secondary and Further Education. Edited by A. J. JENKINSON and W. A. SKINNER. Vol. 5, No. 11. Bolton: Technical College, Manchester Road. Pp. 81-168. Price 5*s*.

The Study of Behavior: Q-Technique and its Methodology. By W. STEPHENSON. Chicago: University of Chicago Press; London: Cambridge University Press. Pp. x + 376. Price 56*s*. 6*d*.

A Review of Productivity in the Furniture Industry. BPC. London: British Productivity Council. Pp. 46. Price 2*s*.

Industrial Training for Manual Operations. By W. D. SEYMOUR. London: Pitman. Pp. xii + 204. Price 20*s*.

Building a Functional Personnel Budget. By D. YODER. Minneapolis: Industrial Relations Center, University of Minnesota. Pp. 12. Price not stated.

Annual Review of Psychology. Vol. 5, 1954. Edited by CALVIN P. STONE. California: Annual Reviews, Inc. Pp. x + 448. Price $7.00.

THE H. M. VERNON PRIZE

Dr H. M. Vernon, an investigator of the Industrial Health Research Board and one of the original investigators of the Health of Munition Workers' Committee in 1915, bequeathed a sum of money to the National Institute of Industrial Psychology for the creation of a Prize to be awarded every second year to the investigator who, being a British subject and under the age of 45 years, has in the opinion of the Council of the Institute done the most valuable research work in the subject of industrial psychology and physiology. The Council has decided that the first recipient of the Prize shall be N. H. Mackworth, M.B., Ch.B., Ph.D., Director of the Medical Research Council Unit for Research in Applied Psychology. Dr Mackworth has a widely established reputation both for his work in directing and developing the studies carried out by this Unit in the field of human skilled performance, and for his personal contribution to a more scientific understanding of the effects of climatic conditions upon human behaviour.

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The Consistency of Stop-Watch Time-Study Practitioners

By WINSTON RODGERS and J. M. HAMMERSLEY

The investigation reported here was sponsored by the Nuffield Foundation. It was carried out under the direction of Mr Winston Rodgers when he was Head of the Industrial Engineering Department at the Acton Technical College. He had the help of a Steering Committee which consisted of Sir Frederic Bartlett (chairman), Professors G. L. Brown, M. G. Kendall, Esther Killick, W. E. Le Gros Clark, Dr O. G. Edholm, Lieut.-Colonel S. H. C. Mound and Mr Alec Rodger. Observers at meetings of the Steering Committee were Dr H. H. Burness, Mr J. G. W. Davies, Mr L. Farrer-Brown and Dr Alexander King. Mr J. M. Hammersley carried out the statistical design and analysis of the experiment.

THE AIM OF THE INVESTIGATION

It was decided that an enquiry should be made into the *consistency* of time-study practitioners in the use of conventional stop-watch procedures. This, it was considered, would be a desirable preliminary to an investigation of other features of their work.

For the purpose of the enquiry the main steps in conventional stop-watch procedures were taken to be the following: (1) A task is subdivided into convenient timing units termed 'elements'. (2) Each element is described clearly. (3) The elements are listed on a time-study sheet. (4) The time taken for the performance of each element is noted with the aid of a stop-watch, used either in snap-back or in continuous-reading style. (5) Each element is timed repeatedly until the observer obtains what he considers to be representative data. (6) Concurrently, the operator's working performance is assessed subjectively, either by 'rating' (in which the operator's pace or speed for each element is estimated numerically) or by 'levelling' (in which his skill and effort are estimated numerically, by reference to a standard scale, to produce the levelling 'factor'). (7) The actual time values for each element are converted to rated or levelled times. (8) Consideration is given to the frequency with which particular elements are found in a given task, and to the totalled rated or levelled times are added certain 'allowances'. In this way a 'standard' or 'allowed' time on the whole task is reached.

ITS DESIGN

For the following reasons, it was decided that the investigation should be carried out at the Acton Technical College rather than in industrial conditions: (1) The enquiry was intended to be exploratory. (2) At Acton, equity in territorial unfamiliarity between observers could be ensured. (3) Favourable and controlled working conditions could be provided. (4) Variables which might lie in the observers might more easily be detected. (5) Questions that might have to be answered subsequently in industrial conditions could be specified more clearly.

Three tasks were devised. S involved the preparation of a solution, A a simple assembly operation, and M a machining operation. These are described in Appendix A. In the planning of them, special care was taken to ensure the minimisation of chance errors occurring through variations in the materials or equipment used or in physical working conditions. In short, the aim was to investigate consistency under favourable circumstances, not to contrive tasks or conditions to prove that experienced practitioners could be inconsistent.

In August, 1949, seven experienced observers took part in a rehearsal; and shortly afterwards invitations were sent to, and accepted by, 11 manufacturing firms, a consultant organisation and a professional body, who between them provided 24 practitioners. The experience of these observers ranged from 6 months to 18 years, with a modal value of 4 years. Only one of the observers was a woman.

When the exact procedure for each of the tasks had been settled, three operators were instructed in its performance. Regular practice periods were prescribed, and observers carried out their studies only when observation of the motion patterns and times of each operator for the task-cycles suggested proficiency in following the prescribed method. The finalised method of performing a task was determined in consultation with the operators engaged on the task. This procedure had the advantage of satisfying operator preference and speeding up the training period.

As it was considered possible that any inconsistencies found might be attributable to differences in the personal characteristics, training or experience of the observers themselves, arrangements were made for each observer to complete two questionnaires, to do a short intelligence test, and to be interviewed. The first questionnaire was of the usual biographical kind; the second was designed to ascertain why the observer had taken up time study, how he had learned his procedures, and what was involved in them. An interpretation of some of the answers is given in Appendix B. The intelligence test was the 20-minute version of Raven's 1938 Progressive Matrices Test, chosen because previous experience had suggested that it might prove both useful and palatable.

The timing of the observers' attendance for the completion of the questionnaires and for the intelligence test was arranged to preclude any possibility of collusion. To meet the requirements of the co-operating organisations, this stage of the enquiry had to be spread over 14 days.

Observers were assured in advance that none of the information they gave would be directly identifiable with any individual.

Time-study S (the preparation of the solution) was compulsory for all observers. Each was allocated a second study in such a way that where there were two observers from the same organisation they covered all three tasks between them. The selection of S as the compulsory study was favoured because it was equally unfamiliar to all the observers and yet presented no serious difficulty.

A special timing set, described in Appendix C, was constructed to record the time intervals in S for selected standard elements (Kinniburgh and Vallance, 1951). The use of standard elements in one of the exercises was included to reduce still further in this instance the number of variables controlled solely by chance.

THE CONDUCT OF THE TIME-STUDIES

The time-studies took six days, with a morning and an afternoon session on each day. During each of the 12 sessions, 2 observers made their studies simultaneously but independently. Each session consisted for each observer of 2 successive studies of S (the solution task), followed by either 2 successive studies of A (the assembly task) or 2 successive studies of M (the machine task). If A appeared in a morning session, M appeared in the afternoon; and *vice versa*.

In the following account, any two observers from the same organisation will be called an O-pair. Any two observers who normally worked together in the same factory will be called an F-pair. Any two observers who carried out a time-study in the same session will be called a T-pair. There were 10 O-pairs, of whom 7 were F-pairs. Only one T-pair was an O-pair; and no T-pair was an F-pair.

For each task at each session, 3 operators were available. One observer of the T-pair selected one of these operators for the first of the 2 successive studies; and the other observer of the T-pair selected a different operator for the second study of this task. In the other task of the same session the order of selection of an operator fell to the observers in the reverse order. Both observers studied the same selected operator simultaneously in any study.

For Assembly and Machine, observers were free to break up the task into elements in any way they wished. This also applied to half the studies of Solution: for the other half both observers of a T-pair had to break down the task into prescribed standard elements, chosen for the convenience of the timing device.

The complete layout appears in Table 1. To read this table, consider the entries for the morning session of Day 1. The two observers concerned were observer 7 from organisation b and observer 1 from organisation a. In the first study of Solution, observer 7 chose operator E, who was then studied by 1 and 7 simultaneously; next for the second study of Solution, 1 chose operator W, who was then studied by 1 and 7 simultaneously, both using standard elements. There followed two Machine studies, the first with 1 and 7 simultaneously studying E chosen by 1, and the second with 1 and 7 simultaneously studying J chosen by 7. The other entries in Table 1 can be interpreted in a similar fashion.

TABLE I: LAYOUT OF THE TIME-STUDIES

DAY	MORNING SESSION	AFTERNOON SESSION
1.	S;E7b,W*1a.M;El,J7.	S;E8c,B*6b.A;E6,B8.
2.	S;B*3e,E24d.A;J24,E3.	S;E*23d,W2e.M;E2,W23.
3.	S;E*4g,W15f.M;E15,W4.	S;E14f,B*5g.A;J5,E14.
4.	S;W20h,E*9h.A;B9,E20.	S;E*10j,W18i.M;E18,W10.
5.	S;W*11k,E17l.M;E17,W11.	S;E*16l,W12k.A;B12,E16.
6.	S;W22n,B*25m.M;E25,W22.	S;E30m,W*21n.A;E21,B30.
	Explanation:—S=Solution, A=Assembly, M=Machine. B, E, J, W are operators. 1, 2, . . . , 30 are observers. a, b, . . . , l, m, n are organisations. Asterisk denotes use of standard elements.	

At the conclusion of both studies, the observers were given a further separate interview, (1) to elucidate the data of the time-study sheets of the observers for later statistical investigation; (2) to supplement the background information record of the observer on Questionnaire A; and (3) to provide the observers with an opportunity to express their opinions about the conduct of the investigation.

With regard to the third purpose of the interview, all observers without exception declared that in their opinion the investigation was very fair, and that they felt satisfied with the times given by them on the jobs studied. The following verbatim comments are typical:

"*The whole experiment was very fair.*"

"*I found the whole project very interesting indeed, and very fair.*"

"*The research has been well thought out and sincerely applied.*"

"*The whole project has been very fair and above-board, and very interesting.*"

"*The project was quite fair. It is a question of putting people at ease.*"

"*We have no excuse to put up if we differ. Conditions differ. We may be influenced in the length of study by ourselves. Again, we are not going to issue this value, we are not going to be responsible for issuing it. There was no need to be nervous on the observation test either. I put up my best.*"

"*The project is obviously fair.*"

"*I feel the project has been scrupulously fair. I have been very happy. This project of yours is an exceptionally good thing. All Time-Study has basic principles. It may go a long way to establish these.*"

"*The whole project has been quite a reasonable set-up, but the point is you are bound to get variations in ratings because of the different tempos different Studymen are used to. Not being accustomed to the* *type of work here, I found it a bit upsetting, but it was well thought out and fair."*

"I have no criticism to make of the project; it has been fair."

"The project has been very fair and very comprehensive; I don't think anything has been left out."

"The project is a good thing. It was fair as far as I was concerned."

"I think it was time something like this was set up. The time-studies were fair. I am glad of the opportunity to contribute."

"You should have had four separate jobs. Apart from that the whole project has been very fair."

"The whole project is quite satisfactory, and should give satisfactory results. I expected to get more studies to do."

"The whole project has been very fair from start to finish."

"The project seems to me very fair. It has been interesting from my point of view."

"The project has been quite fair to us. You have tried to keep us at our ease and we have been given every advantage. I have been very happy about it."

"The project has been very fairly run, and very ingeniously organised."

"The project has been quite fair. I enjoyed it and it has been interesting."

The two observers, a T-pair, for the morning session were normally available by 9.15 a.m. Their attendance for Stage 1 of the enquiry assisted greatly in their being able to maintain the programmed time-table and in minimising that strangeness normally resulting from new association with a locality and work-place.

The purpose of the enquiry and the nature of the tasks was first outlined. Every endeavour was made during this stage to assist observers by answering queries both in relation to the nature of the investigation and the tasks. An assurance was given that in no circumstances would results be published so as to be directly associated with participating firms or individuals.

When the observers expressed themselves as satisfied, three operators *simultaneously* commenced task S. They continued to work until one of the observers, deputed during the introductory conversation, had made his choice of the operator he wished to study. The selected operator was informed and continued to work whilst both observers prepared to make their time-studies. Observers were entirely free to determine the number of cycles they wished to observe, both before and during studies of the task.

When observers expressed themselves satisfied with the study taken, they were requested to complete their studies. Any further queries which may have arisen were answered and the two observers proceeded to make a second study on task S. In this instance the choice of operator lay with the second observer, but he was not permitted to select the operator chosen by his colleague. As in the previous study, the operator now chosen continued on the task, until both observers expressed themselves satisfied with the number of cycles observed for the purpose of their study. This study was worked out and then collected. In one of the two studies (as specified by

Table 1) both observers used the standard elements prescribed for the task. These standard elements were both described and demonstrated to the observers.

Both observers now proceeded to the second task allocated to them. Again they had the opportunity of selecting one of three operators working simultaneously. In this instance the observer who had the second choice of operator in the morning session was allowed first choice of operator for the first study. For the second study on the same task the second observer was permitted to choose the operator, but as in the morning session, was not allowed to select the operator previously chosen. In this second task standard elements were not a feature of either of the studies.

ANALYSIS OF THE RECORDS

The records submitted for analysis consisted of times from the recording device for Solution, and observers' study sheets for all three tasks. For each element of each study by each observer, the following records were prepared:

(i) Observer's Elemental Recorded Time. This is the arithmetic mean (over all cycles except those which the observer marked as not being representative for the element in question) of the times entered by the observer on his study sheet as his stop-watch reading (or the difference of two such readings in the case of observers using continuous timing).

(ii) Observer's Elemental Rating. This is the observer's selected rating for the element in all cases where the observer quoted a selected rating. In cases where he does not, it is the arithmetic mean of his rating figures over all cycles except those which the observer marked as being not representative. The Observer's Elemental Rating has been scaled so that 1.00 invariably represents the standard rating (whichever of the figures 60, 80 or 100 the observer used) and is expressed to two places of decimals.

(iii) Observer's Elemental Selected Time. This is the observer's selected time in all cases where he quotes one. If he does not quote one, it is the normal time that he quotes for the element divided by Observer's Rating, as defined in (ii).

The results of (i) and (ii) have been scaled so that they are in minutes to two places of decimals (whatever units of time the observer used). There was then determined for each study by each observer:

(iv) Observer's Recorded Time. This is the sum of the quantities (i) taken over all elements used by the observer.

(v) Observer's Weighted Rating. This is the weighted mean (over all elements) of the Observer's Elemental Rating, the weights being the corresponding entries for Observer's Elemental Recorded Time.

(vi) Observer's Selected Time. This is the sum of the quantities (iii) taken over all elements.

(vii) Time from Recording Device. This is the mean time of a cycle for Solution, taken from the records from the recording device and expressed in minutes to two places of decimals. A certain amount of judgment was used in rejecting abnormal cycles and confining attention to cycles for which there are corresponding observers' records; and in doing this it was not possible to adopt entirely consistent criteria.

(viii) Allowance. This is taken directly from the observer's study sheet and expressed to two places of decimals on the basis of $(1+x)$ for $100x\%$ allowance. When observers have used various allowances for different elements, the Allowance is taken to be the weighted mean of these allowances over all elements, with weights equal to the product of Observer's Elemental Selected Time with Observer's Elemental Rating.

(ix) Company Policy. If it appeared that the observer was making additions for reasons which were not allowances in the ordinary sense of the word (*e.g.*, for wage policy, rounding of results in favour of the operator, etc., rather than for fatigue, personal needs, etc.), an entry has been made under this heading of $(1+x)$ for $100x\%$ addition. The decision to place an entry under (ix) rather than (viii) is nevertheless somewhat arbitrary.

(x) Observer's Arithmetical Error. An entry of $(1+x)$ under this heading means that the observer made arithmetical errors in working out his result, which inflated it by $100x\%$.

(xi) Observer's Final Figure. This is the observer's final result, as a standard time, taken from his study sheet and expressed in minutes to two places of decimals.

(xii) Check. This is the product of (v), (vi), (viii), (ix), and (x). It should agree with (xi), but may in fact differ from it by ± 0.02 due to rounding off errors.

TABLE 2: SOME SPECIMEN DATA

LINE	TIME FROM RECORDING DEVICE (vii)	OBSERVER'S RECORDED TIME (iv)	OBSERVER'S SELECTED TIME (vi)	OBSERVER'S WEIGHTED RATING (v)	ALLOWANCE (viii)	COMPANY POLICY (ix)	OBSERVER'S ARITHMETICAL ERROR (x)	OBSERVER'S FINAL FIGURE (xi)	CHECK (xii)
1.	1·17	1·16	1·16	1·10	1·12	1·00	1·00	1·42	1·43
2.	1·12	1·11	1·11	1·17	1·12	1·00	1·00	1·44	1·45
3.	1·17	1·12	1·12	1·03	1·13	1·60	1·00	2·10	2·08
4.	1·17	1·11	1·11	0·98	1·11	1·00	1·00	1·20	1·21
5.	1·03	1·03	1·03	1·00	1·00	1·77	1·00	1·80	1·82
6.	1·03	1·01	1·00	0·99	1·00	1·00	1·00	1·00	0·99
7.	1·28	1·34	1·30	1·25	1·15	1·02	1·02	1·95	1·94
8.	1·02	0·93	0·92	1·35	1·13	1·00	1·00	1·40	1·40

Table 2 shows some of the quantities, defined above, which were obtained for Solution. The complete table, from which the above specimens were extracted, is too voluminous to be easily reproduced; and in any case could not be given without breaking the assurance that results would not be published in a form whereby they could be directly associated with the participants. In Table 2, lines 1 and 2 are the two studies of the observer who adopted the simplest procedure (no breakdown into elements, only a mere division of the total time for the task by the number of cycles observed, followed by multiplication by the allotted quantities (v) and (viii)): the corresponding final figures are close to the average of the final figures of all other observers. Lines 3 and 4 are the simultaneous studies of a T-pair; and so are lines 5 and 6 of another T-pair. Lines 3 and 5 are the studies of an F-pair; and lines 4 and 6 are the studies of an O-pair. Line 3 gives the greatest final figure of any of the 48 studies of Solution; and line 6 gives the least. Line 7 shows a study in which the time from the recording device was a maximum, despite which a relatively high rating was given. Lines 7 and 8 show bad timing errors in (iv). The specimens of Table 2 have mostly been selected to show aggravated examples of inconsistencies that arise between observers. The remaining data, not reproduced here, show some or all of these features in less extreme form. Similar data arise for Assembly and Machine.

To analyse the data further the quantities (vii), (iv), (vi), (v), (viii), (ix), (x), (xi) and (xii) were transformed to a logarithmic scale. The purpose of this transformation is to reduce the multiplicative structure of time-study to an additive structure suited to statistical analysis. It also has the advantage of yielding results on inconsistency in the form of percentage error in the quantities analysed. The sources (viii) and (ix) were pooled together, and all timing errors and arithmetical errors were combined. The resulting figures were subjected to analyses of variance and/or of covariance to see how the observers' final results depended upon

(*a*) operator's time,
(*b*) observer's timing errors and arithmetical errors,
(*c*) observer's weighted rating,
(*d*) allowances and company policy;

and to see further how these sources of inconsistency were distributed over the various combinations provided in the layout of Table 1.

CONCLUSIONS

A graphical analysis of Observer's Elemental Ratings against time does not show any body of agreement amongst observers either on choice of elements or on appropriate rating variations between such elements.

A graphical analysis of the average times taken by operators for a cycle of a task plotted against the day and session suggests that the operators improved and became quicker as the experiment proceeded.

The data for Assembly and Machine are not amenable to quite such detailed analysis as is possible for Solution. Nevertheless, all the results that have been established for these first two tasks, agree remarkably well with the corresponding results for Solution. Thus it seems fair to quote results applying in common to all three tasks, even though in a few cases such assertions have been established for Solution only; and this is done below.

None of the following factors have shown any significant influence upon observers' inconsistencies:

(*a*) which operator was studied,
(*b*) whether the study was the first or the second of a pair of successive studies,
(*c*) whether or not standard elements were used.

This is not to deny that these factors have any influence; the assertion is merely that, whatever influence they may have, it is swamped by other dominant sources of error. If time study were more exact, this conclusion might no longer hold.

On the other hand, there is strong evidence that on average an observer agrees with himself more closely than he does with his mate of an O-pair; and that in turn observers from the same organisation agree with each other more closely than they do with observers from other organisations.

In the following paragraphs the degree of inconsistency between observers is described in terms of standard deviations of percentage variation. All such figures must be interpreted accordingly. Thus, when it is stated that the standard deviation of the variation in observer's final figures is 21%, this means that, if the average final figure of a group of typical observers is x, about two-thirds of the observers in this group may be expected to produce final figures not differing from x by more than ±21% of x, whilst nearly all observers may be expected to provide figures not differing from x by more than twice this percentage of x. In this case, nearly all observers should give final figures lying between $0.58x$ and $1.42x$, a ratio of rather more than 2 to 1 between the highest and lowest estimated final figure.

There is 7% standard deviation in the variation of times taken by the operators to perform an average cycle of a task, this variation being in part due to differences between the performances of different operators and in part due to differences between performances of the same operator on different occasions. This figure represents the variation which occurred in this experiment under laboratory conditions: there are no reasons to suppose that it would remain valid in other circumstances. Of this 7%, 5% standard deviation arises from differences in operator performance between the two studies of the pairs of successive studies, studied by the same observer, that is to say within such pairs; and a further 5% standard deviation arises from differences between such pairs. (It is worth noting that here, as elsewhere, the combination of two sources of variation is not by straightforward addition; and that two separate components of 5% each combine to give an overall component of 7% and not 10%.)

If all observers were able to rate perfectly they would, in producing their final figures, compensate entirely for the variation of 7% noted. If each observer had a perfectly self-consistent method of rating, but different observers had different methods of rating entirely inconsistent with one another, the observers in the experiment would compensate entirely for the 5% variation within pairs of successive studies, but would leave the second 5% between pairs uncompensated. The analysis shows that this second 5% has not been compensated in any way, whilst 55% of the first 5% has been compensated. The immediate conclusion is that individual observers are 55% self-consistent at rating, but that they are wholly inconsistent with one another. But this immediate conclusion is not necessarily the meaningful conclusion. Self-consistency does not necessarily imply that the observer is able to appreciate operator's speed: it merely means that his figures for that are self-consistent, and it is not inconceivable that this is due to subconscious or even deliberate adjustment of them.

The standard deviation of the variation in the Observer's Final Figures within the pairs of studies made by the same observer is 3%. This 3% variation consists almost entirely of what remains of the first 5% (discussed earlier) after reduction of 55% rating compensation; all other contributory sources of variation are effectively negligible. If one assumes that the observers in this experiment were typical of study-men in general, one may infer that this figure of 3% standard deviation measures the variation to be expected in a given typical observer's final figures (that is to say, it measures the self-consistency of study-men). Two provisos apply: firstly, this percentage might be lowered when study-men in industry habitually take more than two studies of a task; secondly, the percentage would presumably be increased (though not necessarily in strict proportion) if there were an increase in the percentage variation of operator's speeds.

Consider next the variation which one may expect between the Final Figures of similarly trained observers (that is to say, within O-pairs*). This variation will consist partly of the 3% arising from individual observers' self-inconsistency, and partly from inconsistency between the similarly trained individual observers. The latter source contributes a standard deviation of 8%, due almost entirely to inconsistencies (between observers) in the allocation of allowances and rating figures (as would be expected from observers who cannot appreciate operator's speed but allot their ratings more or less at random within a certain band of values characteristic of their method of training or organisation). It is difficult to break up this 8% into two components due to allowance and to rating variations respectively; for these two sources seem fairly strongly correlated (coefficient of correlation = +0.7), in that the observer (from a given organisation) who rates generously also tends to give generous allowances. The two components of 3% and 8% combine to give a total variation of 9% standard deviation between Final Figures of similarly trained observers.

Finally consider the variation to be expected in the Final Figures between observers in general. There will be 9% variation between similarly trained observers. To this must be added 19% standard deviation due to variations between different organisations (or methods of training). The larger part of this 19%, say five-sixths of it, is due to inconsistencies (between organisations) in their methods of rating, allowances, and company policy. It is difficult to separate these last three components from one another, but it does appear that the organisation which is generous in its rating tends to be strict in its allowances and company policy (coefficient of correlation = −0.4). The 9% and 19% combine to give an overall variation of 21% standard deviation.

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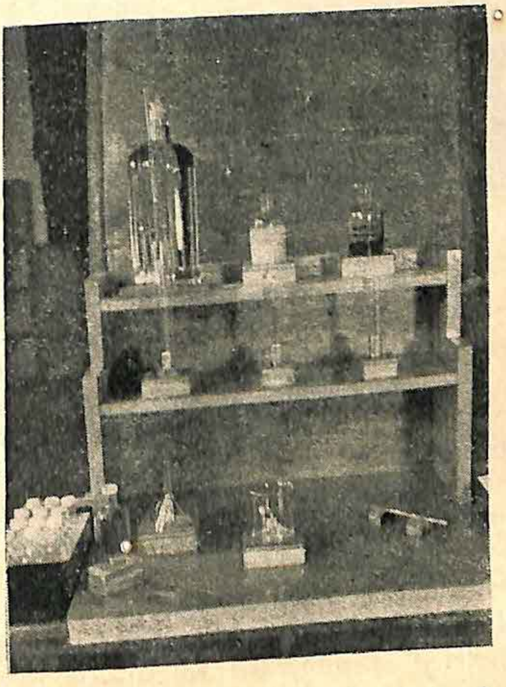
* Biographical details of observers suggest that although they were employees of the same firm their training in time study was not necessarily similar.

This figure of 21% is of greatest interest because it measures the error which one would expect from a typical observer drawn from the aggregate of all study-men of various creeds and organisations. Or it can be interpreted as measuring the inconsistency within such an aggregate. One commonly hears time-study spoken of as being a procedure accurate to about 3%; this would imply a standard deviation of 1½%. The inference is then that this experiment has shown that time-study is fourteen times as inaccurate as it is commonly supposed to be.

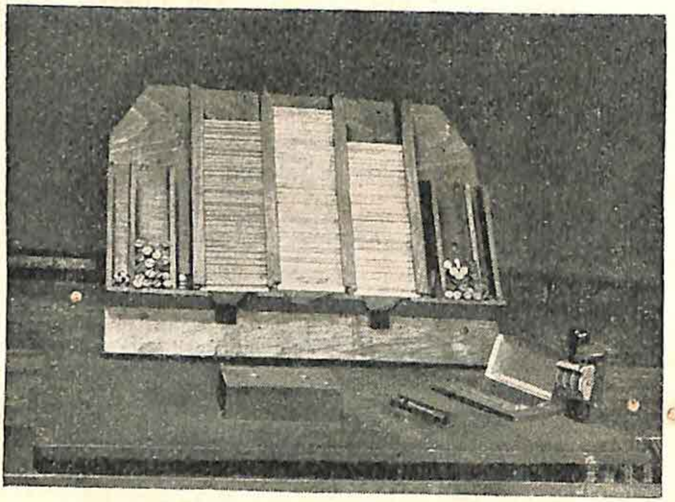
APPENDIX A: PROCESS DESCRIPTIONS

S, the Solution Operation



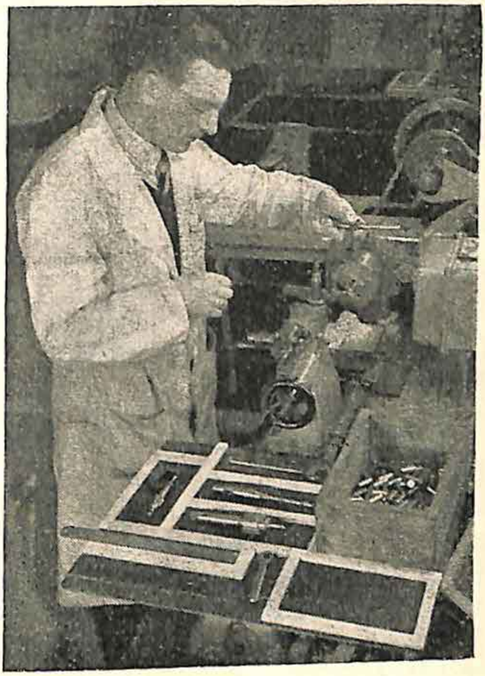
The operator places one stoppered empty bottle in the fixture provided. 80 ± 5 c.c. of water are now syphoned into a 100 c.c. measuring cylinder. This water is transferred to a 250 c.c. beaker and the measuring cylinder is returned to its fixture. 10 ± 1 c.c. of yellow liquid are now measured into a 10 c.c. measuring cylinder from a glass-stoppered 250 c.c. re-agent bottle. The yellow liquid is also transferred to the beaker, the 10 c.c. measuring cylinder and the re-agent bottle being returned to their respective fixtures. 10 ± 1 c.c. blue liquid are measured and added in a similar manner to the contents of the beaker. The mixture is homogenised with the aid of a glass stirrer. The screw cap of the bottle is now removed and the contents of the beaker transferred to the bottle with the aid of a funnel. The beaker and funnel are then returned to their respective fixtures. After the cap has been screwed on to the bottle, it is placed in a filled-bottle container. The operator is kept supplied with the necessary liquids and bottles.

A, the Assembly Operation



The operation was intended to simulate the assembly of three 2 πF condensers and three 1 πF condensers, represented by red and brown cards respectively. The condensers are clamped between two plates, the whole assembly being secured by two OBA bolts, washers and nuts. The assembly commences with the operator removing two OBA bolts from the storage fixture and locating them in the assembly fixture. Two washers are then placed over the bolts, after which the first clamp plate is located over the bolts. One red and one brown card are then removed from the storage fixture and located over the bolts, followed by two further red and brown cards. These cards are assembled alternately. The top clamp plate is then located over the bolts and the assembly secured by two washers and nuts. The nuts are loosely placed over the bolts by hand and tightened with a box spanner. The completed assembly is then date stamped and placed in a storage box. It must be assumed that the operator is constantly supplied with parts by a labourer, and that the completed assemblies are removed by him.

M, the Machining Operation



The machine is an Atlas 3½″ centre lathe, and the raw material for this operation is a piece of ½″ dia. brass rod 1″ long. It will be noticed that one end of the piece is faced clean and the other has a parting pip on it.

To prepare a bush, the operator picks up one of the pieces from a container and places it, pip inwards, to a depth of approximately ⅝″ into a 3-jaw self-centering chuck. A centring drill is placed in the tailstock and a centre made in the end of the piece. The centre drill is now removed and a ¼″ drill placed in the tailstock and the ¼″ dia. hole drilled right through the piece. The ⅜″ dia. is now turned on the outside for a length of ¼″, the machine is stopped, and the part is removed from the chuck and laid aside. All the machining feeds are performed manually and tolerances are laid down. The operator is kept supplied with pieces by a shop labourer.

APPENDIX B: AN INTERPRETATION OF ANSWERS TO A QUESTIONNAIRE

Recruitment, Selection, Education and Training of Time-Study Personnel

The time-study personnel of the Companies represented are mainly recruited through newspaper advertisements, from other departments of the Company, and through personal contact outside the Company. Three-quarters of the observers stated that in their department no one was a University graduate, or held similar qualifications. Salary scales vary, though at the time of the enquiry the general range appeared to be £300-£650.

The most common departmental titles for time-study and related activities are (a) Time-Study, (b) Planning, (c) Production Study. (b) and (c) are titles which do not seem to be popular with the observers. There is no substantial agreement on what the title should be.

Less than half the departments represented use process charts and process questionnaires ; only about one-tenth use film analyses and chronocyclegraphs; and none use methods-time measurement. The observer's knowledge of these, together with their knowledge of time-study and synthetics —the major activities—is obtained through three main sources:

attachment to an experienced time-study man,
technical colleges, and
private reading.

Although the overwhelming majority (95%) of the observers are in favour of formal programmes of instruction in these techniques for practitioners, they are fairly evenly divided in their opinion as to whether such courses should be conducted inside or outside the Company. Three-quarters of the Companies represented would appear to have internal facilities for running such courses. Courses of two to three months' duration would satisfy half the observers; the opinion of the others is again evenly divided on shorter or longer courses. About two-thirds of the Companies do not conduct programmes of instruction in these techniques for other members of managerial or supervisory staff, or for workers' representatives.

The Use of the Stop-Watch

The decimal minute watch appears to be used slightly more frequently than the seconds type. All observers considered their stop-watches reliable. 80% of accuracy-checking is done by comparing the watch with other stop-watches, or against a master-clock. In the taking of times, some 80% of the observers used snap-back as opposed to continuous method.

Assessment of Operator Performance

Assessment was generally done element by element. Most of the observers were unaware that rating and levelling were different techniques for assessing operator performance. The factors which the observers claimed to assess were by no means the same in all cases. Some observers found it difficult to express in words what they were assessing.

Most observers claimed that checks had been made of their ability to assess operator performance. Such checks were usually done by a check study against assessment by another person or persons at periods not definitely specified. Most observers believed that an accurate assessment was possible, often for very different reasons. More than half claimed that if simultaneous time-studies were taken by more than one member of their department their results would not differ by more than 5%*. Only 6% of the observers stated that a difference of more than 10% would result.

*Notice the distinction between this phrase "not differ by more than 5%" and the phrase "accurate to about 3%" used in the paragraph preceding Appendix A. The latter phrase is equivalent to "not differ by more than about 6%", since 6% is the difference between the extreme result, which is 3% too low, and the extreme result, which is 3% too high.

Four-fifths of the observers thought that their assessment depended on their own familiarity with the process. Most who held this view held it firmly. Four-fifths considered it did not depend at all on having a good knowledge of the operator. Of the remainder, most thought that it depended quite a lot.

Computations

All time-study computations were undertaken by the observers themselves, although they might have some clerical assistance. 50% of the observers carried out their work without clerical assistance.

Incentives

Only half of the observers were able to answer questions on wage incentive payments, through lack of information, but it seemed clear that time standards are established for three purposes: as a basis for incentive schemes, for planning labour schedules, and for estimating costs.

Status of Practitioners

Most observers considered that the status of practitioners could be improved by some course of training which would be recognised as giving professional status, and by a greater appreciation on the part of managerial and supervisory staffs of the importance of time-study work.

APPENDIX C: DESCRIPTION OF THE TIMING-SET

Suitably mounted on the solution-task fixture were micro-switches located at points where they could register the removal and replacement of the various items of equipment. Positioned remotely from this fixture but connected to it by a twelve-wire cable was the timing-set. This instrument fulfilled the following functions:

1. It provided an accurate record (± 0.05 sec.) of the time taken to perform each element of the operation, as well as the total time taken to make up any given number of bottles.
2. It ensured that the operator performed the operations in an agreed sequence. Failure to do so was instantly recorded on the timing-set.
3. It measured the consistency of operator performance and thus provided valuable data when comparing the time-study engineers' remarks on the operators' performance.
4. Finally, it kept a check on the number of complete cycles of the operation, thus avoiding dispute.

It was decided that the readings on the timing-set dials should be recorded manually, although provision had been made to provide a photographic record. This decision was taken to minimise the risk of either camera failure or loss of records during the development of the film, etc. In all cases, two observers were used to take the readings; the first to observe and operate the timing-set, and the second to record the results dictated to him.

Five switches are so mounted in relation to the various items of equipment that each one operates when the appropriate item of equipment is removed or replaced. Each switch is connected to the contacts on the arc of a rotary selector. The arm or wiper which is connected to the selector driving-mechanism is in contact with outlet *one* of the selector. Hence, when the first switch is closed the selector driving-mechanism operates, causing the wiper to step into the next outlet. Thus, if the sequence of operation is correct, *i.e.,* each item is moved in its proper turn, the switches in closing will cause the wiper to step from outlet to outlet until it returns to outlet *one,* when the cycle can be repeated. Mounted on the same shaft as the first rotary selector is a second selector which rotates in conjunction with the first. Connected to the outlets of this second selector are the electro-magnets which operate the recording stop-watches.

The principle of the timing-set will now be clear. As the wiper of the first selector reaches outlet *two,* the wiper of the second selector steps forward as well to operate the electro-magnet of the first stop-watch. The first stop-watch is thus started. The closing of the second switch causes the selectors to step into the third outlet, so stopping stop-watch *one* and starting stop-watch *two.* This series of operations continues until the first switch is closed once again. At this point the last stop-watch stops and the wipers return automatically to outlet *two,* thus re-starting stop-watch *one.*

REFERENCE

KINNIBURGH, W. and VALLANCE, L.S. (1951). The Accuracy of Time Study Methods in Brick Laying. *Engineering,* 171, 353-354.

Experiments on the Acquisition of Industrial Skills

By W. DOUGLAS SEYMOUR

Mr Seymour has recently been a Tube Investments Research Fellow in the Department of Engineering Production in the University of Birmingham. This paper is a report on the first phase of an investigation into the nature and acquisition of industrial skills.

PURPOSE AND SCOPE

As part of a project for studying the nature and acquisition of industrial skills experiments have been carried out on the operation of a capstan lathe. The main purpose of the first experiment reported below was to determine whether on such tasks a part or a whole method of training was preferable from the point of view of the level of performance attained after a fixed learning time. It was hoped also that in the course of the experiment more knowledge would be gained about the rate at which skill is acquired in the parts or elements of such a task.

GENERAL EXPERIMENTAL ARRANGEMENTS

It was desirable that the situation should be as realistic as possible for the trainees, but in view of the risk of accidents arising from inexperienced persons operating the capstan it was decided that the operation should be simulated as accurately as possible without the machine itself being power-driven.

Fourteen volunteer undergraduate subjects were used, seven males and seven females. Most of them were in their late teens or early twenties, and none had any experience in capstan work. They were randomly divided into two groups, and after group instruction on the operation of the capstan they each did half-hour daily periods of concentrated tuition and practice. One half of the group continued from the beginning to do the whole operation right through, and were informed at intervals of their progress and time taken; the other half after being shown the operation right through practised it in parts and did not put the parts together until a prescribed 'target' time had been attained on each. After a week's practice the subjects did a 15-minute test run. In both practice and test runs they were asked to work as hard as they could, and a high level of effort and enthusiasm was sustained. All the practice and test runs were done in the laboratory under controlled conditions; the times were recorded for each element of each practice as well as for the test runs, and certain runs were filmed. This first experiment was divided into two parts separated by an interval of about four months.

THE APPARATUS

(*a*) *The capstan and its electrical connections*

The capstan used was a Ward 5″ of unknown vintage. Its mechanical condition was reasonably good and its general state similar to that of many older capstans to be found in present-day factories.

A constant sequence of operations was arranged on the machine, thus:

1. Pick up component, insert in collet and lock collet.
2. Switch on to slow speed.
3. Wind in cross-slide tool.
4. Wind out cross-slide tool.
5. Switch on to full speed.
6. Operate six turret tool positions.
7. Switch off.
8. Unlock collet, remove component and place aside.

A general plan of the arrangement of the apparatus is shown in the photograph, Fig. 1.

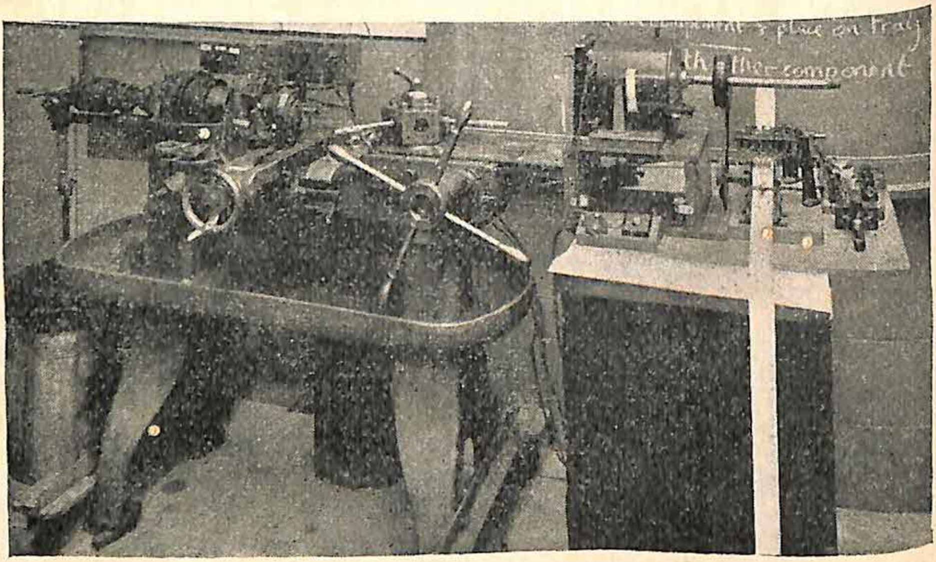


FIGURE I

Electrical connections for the timing of each individual element of the operation were made as follows:

1. The components, two in number and used separately, were each placed on a small spring-loaded hopper, and when lifted, allowed a contact to be closed.
2. When a component was inserted into the collet and the collet lever pushed forward, this depressed a small button switch.

3. The speed switch had three positions—stop, slow and fast. The last two each had an electrical connection in the timing gear and on the indicator panel.
4. When the cross slide was wound in to stop, the slide carriage compressed a small leaf spring thereby operating a switch.
5. The withdrawal of the cross slide operated a similar switch.
6. The turret was equipped with only one switch which operated when the turret had been turned through all six positions, *i.e.,* through 360°.

Each of the switches was wired first of all to a relay box mounted just above the head. When the component was lifted from the hopper the current operated the first relay, thereby closing the circuit ready for the operation of the next element—insert component and close collet. When the collet lever was closed and its switch operated a small indicator lamp on the front of the relay box lit up. The closing of the collet lever switch not only caused this light to come on, but also operated the second relay which prepared the third circuit—that for the slow speed switch. Similarly throughout the sequence the closing of each switch not only lit the appropriate indicator lamp but also operated a relay for the next circuit, and thus a check was kept on the accuracy of the operator's sequence of movements.

As each indicator lamp was lit the circuit was completed from it to the appropriate pen on a paper tape recorder. This six-pen recorder operated in the usual way and the elapsed times for each element of each cycle of the task were measured by means of a graduated perspex scale under which the lengths of tape were passed.

(NOTE: The results arising from these detailed Kymograph records will be discussed in a later article.)

In order to enable the parts of the operation to be practised independently it was necessary to be able to cut out the operation of the relays so that the third, fourth and fifth elements, etc., could be practised independently. The relays were cut out by means of a switch which is shown in front of the timing gear in Fig. 1, and which was operated by the experimenter.

(*b*) *Adaptation of the capstan for the second part of the experiment*

During the first half of the experiment (see below) the subjects went through the motions of operating the capstan, but there was no limitation on their speed of movement. In the second part of the experiment, however, during which the perceptual characteristics of the task were simulated, additional apparatus was installed to give the correct 'feel' of feeding the tool on to the work. This additional apparatus was as follows:

1. At the back of the machine and immediately behind the cross-slide, an oil filled drum was situated which acted as a dashpot. When the cross-slide hand-wheel had been turned to such a point that the dummy tool had reached the component, a steel wire attached to the back of

the cross slide began to lift a piston in the cylinder of oil. This wire was actuated by a steel sleeve fitting over a collapsible spring. If, therefore, the pressure applied by the operator in winding the tool was too great this spring collapsed before transmitting the pressure on to the cylinder of the dashpot, and if the spring collapsed then a switch was actuated which operated a red warning light on the front of the relay box to indicate that the operator had made scrap, and at the same time the recording was cancelled.

2. A similar mechanism was fitted for the operation of the dummy turret tools. A bar of metal was inserted through the bar feed and, as shown in the photograph, this was linked by wire rope to the operating arm of a piston in the dashpot situated on the floor of the left-hand side of the machine. When turret tools were applied to the right-hand end of this bar (which projected through the centre of the ring-shaped component) the bar was pushed back through the bar feed hole and raised the piston in the cylinder of oil. The pressure applied by means of the dummy tool was, however, applied through a spring loaded cap, and again, if the pressure applied was too great the spring inside the sleeve collapsed and operated the red warning light.

The dashpot mechanism and springs were so adjusted that the pressures required were similar to those which would be used in doing actual work on a capstan of this size. The springs in each of the turret tools were different and required different levels of pressure for correct operation.

THE SUBJECTS

From a number of University students who volunteered for the experiment, fourteen were selected at random, and these were randomly divided into two groups of seven—one group therefore had four men and three women, and the other three men and four women.

Two subjects, J. E. and D. G., were selected at random for filming. The films were not continuous but showed representative cycles, and as they did not appear to affect the subjects' performance the results were included in the appropriate groups. No conclusions have been derived exclusively from the films, which were used as a record of the experiment.

EXPERIMENTAL PROCEDURE

(a) *First part of the experiment*

The purpose and procedure of the experiment was first outlined to all subjects. Then, when these had been divided into two groups, the group to be trained by the whole method was assembled round the capstan and its method of operation explained. As will be seen from the photograph, Fig. 1, all the parts of the machine were labelled for ease of identification. Every movement was explained and demonstrated in the correct sequence, and the result of failing to follow the sequence was shown. The method of operation of the signal lights and of the recording apparatus was also briefly explained. Subjects were also told the 'object of the exercise', but were not told the difference in training methods (i.e., part and whole) to be followed by each group. In order to prevent any undue comment on methods of training, the whole method was taken first, as it was thought probable that this would excite less notice. The subjects were informed that they would be told their results and that, although the main results of the experiment would be judged from the number of cycles completed in a fifteen-minute test run on the fourth day, the detailed records of improvement would also be important.

The sequence of movements was demonstrated again and then each subject attempted the task, and completed it correctly.

On subsequent days the subjects came each for half an hour, according to a pre-arranged time-table, and those on the whole method continued to practise, attempting to go as fast as they could following the correct sequence. The correct hand and arm movements were demonstrated and explained to each subject individually, and an appropriate stance was shown. Their overall time for one cycle was called out to them at intervals, and they were told the 'target' time—15 seconds. The target time had been calculated by an experienced time study engineer and represented an average experienced worker's speed.

The subjects on the whole method rested at the end of each five-minute 'burst'—or more often if they desired, though this rarely occurred. At the end of the third day's practice they did a five-minute run, and on the fourth day, after a brief 'warming-up', their test run of 15 minutes.

The explanations given to the part-method group, and the experimental procedure, were similar, but in addition the procedure on parts was explained. They saw demonstrated, and repeated, the whole cycle and then were told that they would be asked to tackle the job in parts first. As with the other group, hand and arm movements were shown and position of stance. Those on the part method were, however, given more detailed targets, which had been previously ascertained, as follows:

(a.1)	Pick up component, load in collet and lock collet lever, switch on	2½ secs.
(b)	Wind in cross slide. Wind out cross slide	5 secs.
(c)	Switch to fast speed. Operate turret	6 secs.
(a.2)	Switch off, release collet and remove component, and place aside	1½ secs.

It was not convenient to practise the first and last of these parts separately since, indeed, the last had to be performed before the first could be repeated. They were therefore practised together (with a combined target time of 4 secs.) until first of all one, then two, then three repetitions could be accomplished in target time. The other parts were practised similarly, each for about five minutes with pauses between, but no two parts (except first and last) were done together until each could be accomplished in target time. When this was achieved the subjects practised the parts in pairs, then in threes, then all together, as follows:

$$\begin{array}{l}\left.\begin{array}{l}a1\\ b\end{array}\right\}\\ \left.\begin{array}{l}c\\ a2\end{array}\right\}\end{array}\qquad\begin{array}{l}\left.\begin{array}{l}a1\\ b\\ c\end{array}\right\}\\ \left.\begin{array}{l}b\\ c\\ a2\end{array}\right\}\end{array}\qquad\left.\begin{array}{l}a1\\ b\\ c\\ a2\end{array}\right\}$$

The subjects on the part method re-commenced on the parts each session and did these separately in target time before combining them. They, like the other group, did a five-minute run on the third day, and a fifteen-minute test run, after preliminary warming up, on the fourth day.

(b) *Second part of the experiment*

The procedure in the second part of the experiment was similar. As the sequence of operations was identical, this was rapidly recalled by all subjects. The differences in the task were explained, *i.e.*

(i) that the component was different, a ring shaped piece having been substituted for a cylindrical plug;

(ii) that the cross slide operation was different, as the winding in was now controlled and had to be done as fast as possible without causing the red light to flash; and

(iii) that, similarly, the turret tools had now to be fed on to the 'work' as fast as possible, but not so hard as to cause the red light to flash. To assist the operators, and to provide a guide comparable to that given by swarf indications on actual capstan work, a line was marked on the dummy tools in such a position that if the sleeve did not obscure the line, then the pressure applied was not too great, *i.e.*, the red light would not come on.

New targets were also provided for this part of the experiment. From time studies it was estimated that experienced workers would require 45 seconds for the completion of the task, and all subjects were told this. In addition, subjects doing the part method were given the following targets:

(a.1)	Pick up component, load in collet and lock collet lever and switch on	4 secs.
(b)	Wind in cross slide. Wind out cross slide	9 secs.
(c)	Switch to fast speed. Operate turret	30 secs.
(a.2)	Switch off, release collet and remove component and place aside	2 secs.

As in the first part of the experiment, a.1 and a.2 were practised together, this time with a target of 6 seconds.

The number and duration of subjects' visits were the same as in the first part of the experiment. Those subjects who had done the whole method in the first half of the experiment did the part method in the second, and *vice-versa*.

As before, the number of cycles of the operation completed in the final fifteen minute run was taken as the main result. Whereas in the first part of the experiment this was a single figure, in the second part the final fifteen minute test results were recorded in three ways:

(i) Number of correct cycles completed.
(ii) Number of errors on the cross slide.
(iii) Number of errors on the turret.

MAIN RESULTS FROM 15 MINUTE TEST RUN

(a) In the first part of the experiment, for which the target time was 15 seconds per cycle or 60 cycles of the operation in 15 minutes, the results were as follows:

TABLE I: NUMBER OF CYCLES DURING TEST RUN

SUBJECT	SEX	WHOLE METHOD
V.P.	M	67
R.P.	M	62
B.T.	M	81
S.K.	F	60
M.C.	F	64
J.E.	F	68
J.G.	F	69
		471
		Av. 67·3
		PART METHOD
D.G.	M	60
C.M.	M	63
L.B.	M	69
P.B.	M	70
J.J.	F	62
D.Mc.	F	65
D.M.	F	66
		455
		Av. 65.0

Comparisons were carried out by means of the *t* test* between the different sub-groups of Table 1, as follows:

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*The help of Dr E. G. Knowles in directing the statistics for these experiments is gratefully acknowledged.

TABLE 2: COMPARISONS

BETWEEN	*t* VALUE	DEGREES OF FREEDOM	SIGNIFICANCE
Whole Method *v.* Part Method	0·780	12	None
Whole Method *v.* Part Method (Males only)	0.813	5	"
Whole Method *v.* Part Method (Females only)	0·348	5	"
Males *v.* Females	0·879	12	"

From these comparisons it will be seen that in this half of this experiment the part method of training used showed no superiority over the whole method, or *vice-versa,* and that this is so both for the male and for the female subjects, and for all subjects together. Also, the male subjects showed no superiority over the female, or *vice-versa,* although no such distinction could in any case be drawn from the results of so small a batch.

(b) In the second half of the experiment the results were recorded not only in terms of cycles of the operation completed, but also in terms of the errors on the cross slide (i.e., occasions when the red light came on) and of the errors on the turret. (No distinction has been made between errors on the different tools of the turret, though the majority occurred with the third tool which required the most delicate pressure.)

The results were as follows:

TABLE 3: CLEAR RUNS, TURRET ERRORS, CROSS SLIDE ERRORS

	SUBJECT	SEX	CLEAR RUNS	TURRET ERRORS	CROSS SLIDE ERRORS
WHOLE METHOD	D.G.	M	6	8	0
	C.M.	M	13	5	2
	L.B.	M	9	6	2
	P.B.	M	22	3	1
	J.J.	F	8	14	5
	D.Mc.	F	12	4	3
	D.M.	F	7	7	4
			Total 77	47	17
			Av. 11.0	Av. 6.7	Av. 2.4
PART METHOD	V.P.	M	20	3	1
	R.P.	M	12	6	2
	B.T.	M	18	5	3
	S.K.	F	17	4	2
	M.C.	F	19	1	0
	J.E.	F	13	7	0
	J.G.	F	22	2	1
			Total 121	28	9
			Av. 17.3	Av. 4.0	Av. 1.3

It will be observed that although the best subject on the whole method scored as many clear runs as the best on the part method, the total of the latter group is higher, and the errors less. Also, the scores of the part method group are much more consistent.

TABLE 4: CONTINGENCY TABLE

METHOD		CLEAR RUNS	TURRET ERRORS	CROSS SLIDE ERRORS	TOTALS
Whole	Observed value	77	47	17	141
	Expected value	93·37	35·37	12·26	
	χ^2	2.87	3·82	1·83	
Part	Observed value	121	28	9	158
	Expected value	104·63	39·63	13·74	
	χ^2	2·56	3·41	1·64	
Totals of Observed Values		198	75	26	299
Totals of χ^2		5·43	7·23	3·47	16·13
		$1\% < P < 5\%$	$.1\% < P < 1\%$	$P < 5\%$	$P < .1\%$
		Total χ^2 with 2 degrees of freedom $= 16{\cdot}13$.$P < {\cdot}1\%$			

As will be seen from the contingency table above (Table 4), the difference between the results, taken as a whole, is statistically significant. The difference between the scores on clear runs—although that for the part method is more than 50% greater than that for the whole method—is only just significant. The difference in turret errors (47 whole method and 28 part method — the former being more than 50% greater than the latter), is significant—and this is the most pronounced difference. Although the cross slide errors show the greatest percentage difference (9.17, or nearly 100%), this is not significant.

On the whole method the men did slightly better than the women; on the part method the women did slightly better than the men. But in both cases the numbers and differences are small and there is very little evidence to suggest that there is any true sex difference.

These results are discussed below.

OBSERVATIONS AND INTROSPECTIONS

(a) Some interesting observations were made of the method in which the subjects approached the task and of the ways by which they improved. All the subjects memorised the sequence of operations rapidly, and this aspect of the task seemed to present little difficulty—perhaps because their level of intelligence was high.

The early attempts tended to consist of a number of discrete movements, each commenced on the termination of the preceding one. As skill developed, the performance became more integrated—in the case of those on whole method, by their own efforts; in the case of those on part method, partially as a result of synthesis. Two stages of integration were observed:

(i) Manual, *e.g.*, to begin with, the left hand moved to the switch *after* completion of the cross slide element; later, subjects tended to leave the left hand on or near the switch, and turned it with minimum travel movement.

(ii) Sensory, *e.g.*, to begin with, subjects turned their eyes to the switch before turning it (even if the hand was already there), later they relied on proprioceptive cues, and their eyes glanced either to the star-wheel after finding the cross-slide or—later—remained fixated on the work throughout, peripheral vision or 'positional cues' being used to locate the star-wheel with the right hand.

(Some of these changes are recognisable on the films.)

A special case of sensory-perceptual development was observed in the handling of the star-wheel. To begin with, subjects reversed the direction of this when they felt, or heard, the bump as it reached the stop at either end. Next, they realised that there was a click just before the stop, and used this as a preliminary indication for reversing the movement. Thirdly, some of the subjects progressed to a third level of skill in this respect—instead of reacting to the stop or to the click, they reacted to the position which the arm was in at the end of the movement as the cue for reversal, *i.e.*, they substituted an internal proprioceptive channel of information for an exterior one. After being observed, these points were checked by questioning subjects.

(b) Performance and Intelligence. All fourteen subjects were given the NIIP Test 70/23. Their test scores and experiment scores showed a correlation of +0.38 with 12 degrees of freedom, *i.e.*, not significant. This low correlation coefficient is not surprising, since if there were any correlation between test scores and experiment scores, the range of the former among highly selected undergraduates is unlikely to be great enough to indicate a correlation.

The experiment therefore would seem to provide no evidence as to whether performance on a task of this sort is correlated with score on a non-verbal intelligence test, though comparison with the results of industrial subjects (to be reported later) may show a clearer picture.

(c) Subjective preferences. All subjects were asked to record whether they preferred the part or the whole method of training on the task. The answers do not give a strict comparison, since subjects had experienced only one method on each half of the experiment. The subjective preferences may be summarised thus:

(i) Appproximately equal numbers showed preference for part and for whole methods.

(ii) Preferences for method do not appear to have directly affected relative performance on the tasks, *i.e.*, those who preferred the part method did not necessarily do better on that method, and similarly those who preferred whole method did not in all cases do better on that method.

DISCUSSSION OF MAIN RESULTS AND OBSERVATIONS

A single experiment of this kind can only very partially elucidate the outstanding problems of industrial training and the acquisition of industrial skills. The experiments here reported do, however, contribute something to our knowledge of this subject and the following points are noteworthy:

(a) In so far as the experiment set out to determine whether a part or a whole method was superior in learning a typical industrial task, the answer is incomplete. The findings in this experiment would indicate, however, that:

(i) Part methods show no advantage in terms of speed of acquisition of skills over whole methods for a 'simple' task, *i.e.,* one in which movement is predominant and where the perceptual requirements of the movements are not stringent or highly co-ordinated. This is indicated in the first half of the experiment, in which a 'progressive' part method of synthesis was used. There is no evidence to suggest that the results would have been otherwise had a non-progressive method of synthesis of parts been used.

(ii) Part methods may have advantage over whole methods for a 'difficult' task, *i.e.,* one in which the perceptual requirements are very stringent and highly co-ordinated, especially if the kinaesthetic and tactual sensitivity involved is high. Under these conditions, the advantage of a progressive part method would seem to show itself not only in a higher standard of performance attained after the same period of training, but in a smaller number of errors. It may be argued, of course, that the superiority of the 'part' method in the second half of the experiment arose from the fact that the subjects using it had previously learnt the same movements on a 'whole' method, or again that the inferiority of the 'whole' method in the second half arose from the fact that the subjects engaged on it had learnt the same movements previously on a 'part' method. Further experiments, to be reported later, have dealt, *inter alia,* with this unlikely possibility.

(b) Despite the points made in (a) above, the outcome of this experiment would seem to be *not* that part methods of training are better than whole methods, or *vice-versa,* but rather that the terms 'part' and 'whole' are misleading and inadequate in these discussions. Elsewhere (Seymour, 1954a) it has been pointed out that many industrial tasks involve no fixed 'whole', but the operators' skills consist largely in the ability to do, on demand, any one of a number of possible combinations of parts. In addition to this practical viewpoint that 'part' and 'whole' are not useful distinctions, we have also here some experimental evidence that the distinction, from the point of view of the acquisition of perceptual motor skills on industrial tasks, is in the relative perceptual content of different parts of the task, rather than between 'part' and 'whole'.

Other experiments (Seymour, 1954b) have indicated that, at any rate in the higher levels of skilled performance on industrial tasks, the later improvements result from shorter time taken on the *more perceptually difficult* parts of a task, and that the time required for a movement depends upon its perceptual as well as upon its spatial characteristics. In the present experiment there is evidence suggesting that elements of a task with high perceptual content require longer training, and that therefore methods which enable greater attention to be concentrated on such elements are advantageous. It may be noted, too, that the greater difficulty in acquiring the highly perceptual elements of a task may be partly responsible for the plateaux in the learning curve when ordinary, whole methods of learning are employed.

It would seem possible, therefore, that the benefits of part methods, wherever and in so far as they manifest themselves in training for perceptual motor tasks of this kind, result not so much from the fact that they *are* part methods as from the fact that such methods enable attention to be concentrated on those parts or elements of a task which are perceptually most stringent and hence require most training time for their successful performance at speed. Thus it might appear desirable to talk, not of 'part' methods, but of 'isolation' methods of training for difficult industrial tasks.

(c) In regard to this, it is worth while to note the points at which difficulties were encountered in acquiring the skills of the task. The major difficulty with these subjects was *not* that of mastering the sequence, which was learned rapidly, and rarely, if ever, wrongly performed. Nor was the major difficulty one of movement, for both the sequence and the movements were overtly the same in both halves of the experiment. The main difficulty was the 'control' in the second half of the experiment—a problem which appeared to be one of perceptual learning rather than motor learning, though of course some movement was involved. It would seem important that explicit recognition should be given to this in any attempts to improve operator training.

(d) The perceptual information reaching the operator from the task comes by no single channel, and information for one and the same purpose may be brought adequately by any one of several channels. Thus, the reversal of the star-wheel may result from information brought either audibly, tactually or kinaesthetically—or by combinations of these channels. The selection of the most economical channel would appear to be an important stage in the acquisition of speed skills.

Recent writers on skill (Welford, 1951) have emphasised the importance of the 'central organisation', in the cortex, of information from a task, prior to the initiation of the response mechanism. Such organisation has to be built up individually, but it is a point of some importance to consider whether this may be better done by the subjects' unaided effort, or whether it may be assisted by training methods. The synthesis of parts followed out in progressive part-method training may have contributed something to this end, though it is difficult to find evidence to demonstrate this.

(e) It will be seen from the subjects' preferences that almost equal numbers preferred the part and the whole methods, but that little can be deduced about the effect of preference on performance. We cannot rule out, however, the possibility that individual differences may interact with methods of training, and that some individuals may be able to acquire skills better on a part method, others better on a whole method.

(f) These considerations also raise the question as to whether acquiring the skills on a task such as this involves the same sort of processes, and follows the same rules, as learning verbal, or arithmetic material or other non-motor tasks. The type of non-symbolic knowledge required in perceptual-motor tasks, and the repetition required in them, appears so different from the symbolic knowledge in other forms of learning, and the recall which is required in them, that there would appear to be, *a priori*, very little similarity in the processes involved.

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An Approach to the Study of Dial Reading

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INTRODUCTION

The importance of dial reading

THE industrial developments of the nineteenth and twentieth centuries have undeniably been associated with a growing tendency for the life of man to be intimately and increasingly regulated by the performance of mechanical devices of his own contriving. Almost within a century man has largely ceased to be a main source of industrial energy and has, instead, assumed the role of a machine-attendant. He has become essentially a monitor—a supervisor whose task and responsibility it is to see that the machines he has invented fulfil properly the functions for which they were designed. And in this ceaseless vigilance which he has accepted in place of the more vigorously active occupations of his forbears he has no greater single aid than the instrument dial. In the first Elizabethan age the only dial commonly demanding attention was that of the timepiece; in the second, the number of dials is legion. Today, in watching the movement of a single pointer, a man may receive information which could otherwise be obtained only by great expense of effort and even greater risk of error; he may even be informed of the existence of a state of affairs of which his unaided senses could not possibly make him aware.

Needless to say, people who take machines for granted accept dial reading in the same way. Rarely, perhaps, have they stopped to consider that facility in the interpretation of a dial is based upon the successful completion of a piece of learning. More rarely have they given thought to the possibilities of conflict that arise from learning similar, but not identical, things; or even to the fact that some things are harder to learn than others. The result of this neglect has given rise to the prolific creation of innumerable types of instrument dials, based at the best upon mechanical expediency and at the worst on chance or individual whim.

If it is impossible to estimate it is certainly not difficult to imagine the enormous amount of damage done and the number of lives lost by mistakes in the reading and interpreting of dials. Yet no serious attempt to investigate basic psychological factors involved in dial-reading appears to have been made prior to the latter stages of the Second World War.

Wartime experiments

The pressing needs of a great emergency have often pointed the way to standardisation of equipment, and to some extent this happened during the war with regard to instrument dials. But insofar as standardisation did occur it was a standardisation determined by speed and ease of production rather than one based upon the psychological study of dial reading as a human perceptual task. The attention of psychologists seems (not unnaturally, perhaps) to have been devoted at that stage to *ad hoc* investigations designed to make particular instruments more efficient, rather than to accumulate a body of knowledge applicable to the design of dials in general.

The need for basic research

Viewed in the light of a task of visual perception, the reading of instrument dials appeared to provide a field of investigation in which one might well hope to establish certain basic principles that might profitably be applied to the design of dials in general. The problem in each individual case is that of perceiving swiftly and accurately the position of a pointer in relation to a graduated scale. There are not many variables in the situation, although there are many ways in which each may vary—or interact with the others. To attempt a study of some fundamental factors of dial construction in their relation to speed and accuracy of perception was the aim of the investigation briefly reported here.

FACTORS TO BE INVESTIGATED

The following simple factors in the design of instrument dials were selected as being worthy of investigation in the first instance:

(a) *Curvature of the dial*. For equal size of unit graduation, does increased curvature increase or decrease legibility?

(b) *Degree of graduation*. Does the use of minor (unit) graduation marks increase or decrease the legibility of a dial as compared with one which is graduated only in multiples of fives and tens?

(c) *Direction of figuring*. Should the figuring on a curved dial follow the circumference (tangentially) or be printed horizontally throughout?

(d) *Direction of pointer*. In curved dials, should the pointer be directed toward or away from the centre of curvature?

(e) *Orientation*—

  (i) In straight or nearly straight scales, should the arrangement be vertical or horizontal?

  (ii) If the arrangement of a straight or nearly straight scale is vertical, does it make any difference to legibility if the pointer is directed from the left or from the right?

  (iii) If the arrangement of a straight or nearly straight scale is horizontal, should the pointer be directed from above or below?

  (iv) In semicircular scales, should the arc be above or below the diameter?

METHODS OF INVESTIGATION

American methods

Loucks in 1944 made a preliminary study of certain factors in the design of aircraft instruments. In doing so, he presented material to subjects tachistoscopically and arrived at certain conclusions, notably with regard to tachometer dials. Later American workers have tended to avoid the use of the tachistoscope.

An attempt to establish a standard method by which the legibility of various types of dial could be quantitatively assessed was made by Kappauf and his associates in 1947. Kappauf, referring to the earlier work (during the war) of Loucks, protested against the "necessarily speeded attitude of the subject in a tachistoscopic experiment". "The natural situation in dial-reading", he contended, "is for most readings to be paced by the subject himself. Even when readings do have to be hurried in accordance with the demands of the task, the dial reader is normally free to check himself by a second glance if he feels it important to do so." He therefore rejected tachistoscopic exposure in favour of a measure of reaction time. To avoid some of the obvious difficulties involved in measuring the reaction time in reading a single dial, the American workers prepared cards each containing a dozen dial faces of similar design but varying pointer readings. These they presented to subjects with the instructions that the various readings be given aloud in order, (a) "under an accuracy attitude" and (b) "under a speed and accuracy attitude". A time-score was obtained from the time required to read the whole card of twelve dials, and an accuracy score was also available from the number of errors made in the course of the twelve individual readings. This general procedure has apparently been followed in several more recent studies by the same group of investigators.

Criticism of Kappauf's method

The present writer agrees that a tachistoscopic presentation is not identical with the normal dial reading situation; but he considers that Kappauf has moved from the frying pan to the fire. In the American method there seems to be no means of distinguishing between speed and accuracy, since neither is held constant while the other is measured; moreover, the time for the oral response to twelve dials read consecutively must include a very large component controlled by the enunciation of the response, and consequently largely independent of the *perceptual* time. Presumably it takes as long to perceive "8" as "28" but the latter takes about three times as long to enunciate. In other words, there is a danger in the American method that the total time for oral response may bear only a small relation to the mean time of perception of each dial — which, after all, seems to be the really important thing to investigate. Further, though the situation of tachistoscopic presentation may *differ* from that of practical dial reading, it seems possible that it may be found to correlate highly with it, just as many aptitude tests, themselves bearing little superficial resemblance to a particular job, may prove of considerable diagnostic value because they measure an important element in the real situation.

Methods used in the present investigation

(a) *A method using "time" scores*

When the Queensland studies were being planned, the writer became firmly convinced that conclusions about the relative legibility of dials containing certain structural differences should be based, wherever possible, not upon a single method but rather on several different lines of approach. Of these, the tachistoscope certainly did not appear to merit summary dismissal.

On considering alternative means the main problem seemed to consist in avoiding any system of measurement which would confuse the time of giving a response with the time of knowing what response to give. In both oral and written responses, the actual pointer-readings (6, 18, 43, etc.) would differ in their influence on the response time. We may presume safely that in an industrial situation the individual who has to respond in some specific way to a dial-reading can begin to do so as soon as he *perceives* what the reading is, not after he has enunciated or written the reading. The use of a lip-key in an ordinary chronoscope circuit was rejected, as the correctness of the response could not thus be checked; and, even more important, the subject would be put in an unnatural state of tension by having to say something quickly to effect a satisfactory score. What needed to be investigated was the relation between the basic design of the dial and the average facility with which the readings were perceived—not the speed with which an individual could subsequently perform some given task using the act of perception merely as a stimulus. In short, what appeared to be required was a method which would measure the shortest time for which a dial must be directly exposed to view in order to be correctly understood immediately afterwards. The word "understood" is preferable to "read", since the latter suggests an oral response not itself a part of the perception.

The subject himself is the only person able to determine the length of time during which a dial must actually be viewed to provide the sense-data for subsequently knowing it. Even he may not be able to do this with much accuracy, but it can hardly be argued that anyone else is in a better position. It was therefore decided that the first method of attack should be by devising an apparatus which would enable a dial to be exposed for a short, controllable, measurable period, and that control of the duration of this period should lie with the subject himself. The accuracy of the response could then be checked by the oral response of the subject at leisure, *after* the completion of the timing, thus removing the anticipatory tension which would certainly exist were the oral response to *determine* the conclusion of the "reading" period. Once the principle had been established, the apparatus was not difficult to devise.

It was decided to use an illumination technique in which the time of the exposure would be directly measurable in terms of the duration of flow of the illuminating electric current. The subject was seated at one end of a box about three feet long, fourteen inches wide and twelve inches high. This box was raised on short legs from the surface of the table on which it rested, so that the eyes of the subject, who was seated on a chair, were level with a centrally placed slot in one end of the box. The subject was thereby enabled to look comfortably into the box, but as this was otherwise completely closed and the inside painted black, nothing could normally be seen. However, the box contained two forty-watt electric lamps at the same end as the slot and, when these were switched on, the inside of the opposite end of the box was illuminated and hence clearly visible to the subject. (The lights themselves were carefully screened to preclude any direct glare.)

The end of the box opposite to the subject was made in the form of a door which could be opened as required by the experimenter, and to the inside of which could be attached a card displaying a dial. An internal flap, also operated by the experimenter, was interposed while the dial was being placed in position, thus preventing the subject from seeing the dial in the light of the open door. When the door had been shut the flap was lowered to the floor of the box, leaving no obstacle between the dial and the subject's eyes. At the subject's right hand (left hand, if preferred) was the knob of a switch key. This key on being depressed completed a circuit which lit the lamps and revealed the dial clearly to the subject, this state of illumination being terminated merely by removing pressure from the key. It was thus possible for the subject, at a time when he felt quite ready and able to concentrate his attention upon it, to illuminate the dial for just as long as he considered it necessary to be sure he could "know" what numerical value was indicated by the pointer. While the key was depressed and the dial illuminated an electric chronoscope was thrown into operation. This ceased to operate as soon as the releasing of the key broke the circuit, the reading of the chronoscope thus representing the time of illumination: (in other words, the time during which the subject was gaining the necessary sense impressions). The judgment of the subject concerning the pointer-reading was given at leisure after the chronoscope had ceased to operate.

(A comfortable black hood fitted to the box and lowered over the subject's head some time before commencing the experiment obviated any difficulties arising from glare or dark-adaptation.)

It was found in practice that very few errors were made by subjects, who had been carefully instructed to keep the dials illuminated for just as long as necessary to ensure an accurate response. However, when the correct pointer-reading was not named the subject was informed that an error had been made and requested to look again. The time taken for the second observation was then added to that of the first, the total thereby becoming the score for his reading of that dial. In a few cases more than two periods of observation had to be insisted upon before the correct answer was given, but these constituted a very small proportion of the total.

(b) *Methods using "error" scores*

Several tachistoscopic methods involving different types of apparatus were employed.

A simple method consisted of varying the illumination circuit of the "black box" used for obtaining time-scores, so that internal illumination was limited to a short constant period, controlled by accurate timing gear. In this case a warning buzzer in the circuit preceded the exposure by a couple of seconds, thus ensuring the attention of the subject during the actual presentation, but allowing natural relaxation while the dials were being changed.

Two mechanical tachistoscopes with vertical shutter movement were constructed, one employing a gravity slide regulated pneumatically, and the other a roller blind with friction brake. With the aid of these, dials could be presented in ordinary daylight as distinct from the artificial lighting involved in the black box. Of these tachistoscopes the former proved more satisfactory and was extensively used. It could not, however, be fairly used for comparisons involving horizontal and vertical arrangements of straight and slightly curved dials, because of its own vertical movement. Consequently another pneumatically controlled tachistoscope was constructed for this purpose. This possessed two shutters, horizontal and vertical, which, acting simultaneously, gave an apparently diagonal movement of the area of exposure. The question of direction of shutter movement was subsequently eliminated entirely by the use of a projector fitted with a "Compur" type camera shutter, and by having the test dials prepared in the form of lantern slides.

PROBLEMS IN PREPARATION AND PRESENTATION

In preparing test dials for presentation by any of the methods just described, close attention had to be given to several important points. For instance, care had to be taken to ensure that the dials used were identical in all respects other than the features which were being deliberately varied. This difficulty was largely overcome by having the cards printed with blocks made from carefully drawn originals, the pointers being superimposed with a stamp at the required positions. The "optical projection" tachistoscope used slides made by photographing actual dials on which the real pointers were set, in each case, at the chosen readings. The readings themselves had to be chosen with care on a "controlled" random basis, to ensure that no type of dial was unfairly biassed by readings likely to present less than average difficulty (*i.e.*, a majority of readings on even multiples of fives or tens, or of integral as distinct from fractional readings).

Some preliminary trials showed clearly that a subject could read up to about a hundred dials at one session without appreciable fatigue. More than that appeared to involve a risk of fatigue, and perhaps a reduction of positive motivation. Consequently the "sets" of dials were not allowed to exceed one hundred, the actual number in each case representing a multiple of the number of individual variables being introduced in each series. For instance, in one experiment where there were five degrees of curvature and two kinds of graduation in dials ranging from zero to a hundred, the total number of dials was exactly one hundred. This meant ten dials of each separate combination, thus allowing for a good distribution of the pointer settings with respect to the intervals of units and tens throughout the whole range of the dial.

The subjects selected consisted of a fair cross-section of the University community—students, academic staff, technicians and administrative staff. All were volunteers, keenly interested, and obviously approached the task seriously. Motivation did not therefore constitute a problem at all.

PROBLEMS IN SCORING

Differences in individual efficiency

Individual efficiency in reading the dials varied a great deal. This variation may have been due to several causes, such as experience and visual acuity. On the whole it was accepted as good rather than bad, as the investigation aimed at studying the influence of variations in design on the public generally rather than in relation to a highly trained group. It was however felt necessary to make some statistical adjustment for this large variation, and this was done by converting raw scores to standard scores in relation to each individual's total performance. In the case of error scores, a factor determined by the total number of errors made by each subject was applied to his scores before combining them with those of other subjects. It may be said in passing that this statistical refinement did not alter the general trend of the results.

Assessment of error scores

Some thought was given to the question of assessing the quantitative value of an error in reading dials tachistoscopically presented. There are clearly arguments against using the simple numerical value of the error itself. In such a case a dial in which one person had made a misperception of ten units, reading "34", say, for "24", would be rated as less legible than another in which nine subjects had each made an error of one unit. After a number of trials with various systems of weighting, it was decided to treat all errors as of equal value—a simple dichotomy of right or wrong. ("Right" consisted of giving the numerical value of the pointer reading to the nearest whole number, an instruction explicitly issued to all subjects, who were warned that the settings might include fractions. Where the setting was at a half, the whole number on either side was accepted as a correct answer.)

Trial analysis showed that the general trend of the results would not have been varied had any of several other systems of weighting the errors been used.

Inconsistency inherent in the system of scoring errors resulting from the use of fractional readings

So long as the subject was instructed "to read to the nearest whole number" — the only practicable procedure — the use of fractional pointer settings carried with it a necessary variation in the number of errors likely to be made, according to the nature of the fraction. In terms of chance probability the readings set at "halves" were easier to get right than those at "quarters", or even whole numbers. Space prevents the full explanation of this here, but it may be said that here again a legitimate statistical correction may be applied, based upon the probably normal distribution of errors of perception about the actual pointer setting as a mean. This correction was used where necessary, but once again the trend of the results would not have been influenced qualitatively had it been omitted.

RESULTS

(a) *Curvature*

In general it was found that a small degree of curvature did not appreciably affect legibility; *i.e.*, a quadrant scale was not appreciably different from a linear scale in this respect. However, dials with higher degrees of curvature—three-quarter circles and full circles—were not as easy to read as those less curved, and this effect was highly significant when the dials were fully graduated. In the case of the "plain" dials the difference was slight. (Main effects of difference in curvature and the interaction between curvature and graduation both significant above .001 level in most experiments.)

(b) *Degree of graduation*

From the entire range of experiments, involving in all over 40,000 individual readings, there was overwhelming evidence in favour of the "plain" as distinct from the fully graduated dial. So long as the subject is required to read only to the nearest integer, the unit graduations (other than those marking multiples of five and ten) appear to present a distracting influence, increasing time taken and risk of error. In each of eleven experiments the difference was in favour of the "plain" dial, and in most of these cases the significance of the difference reached or exceeded the .001 level.

(c) *Direction of figuring*

There was a difference in favour of horizontal as distinct from tangential figuring in curved dials. (.05 level.)

(d) *Direction of pointer*

Greater legibility is secured when the pointer is centrifugal (*i.e.*, on the inside of the curve, as the hand of an ordinary clock) than when the pointer approaches the scale from the outer side of the curve. (Far above .001 level.)

(e) *General orientation*

(i) In each of three experiments in which the horizontal and vertical arrangements of straight or nearly straight scales were compared the difference was in favour of the horizontal orientation. (Levels of significance: .001, .01 and .01 respectively.)

(ii) Where a linear or slightly curved scale is arranged vertically, there is decided evidence in favour of the arrangement in which the pointer is on the right hand side of the scale, and the figuring on the left, rather than *vice-versa*. (Level of significance: .001.)

(iii) Where straight or nearly straight scales are arranged horizontally, they are easier to read if the pointer is above the scale and the figuring below, rather than *vice-versa*. (Level of significance: .05—.01.)

(iv) In semicircular scales there is good evidence from three experiments (involving several thousand readings) that the dial is easier to read if the diameter of the semicircle is at the base rather than at the top. The significance of these differences reaches the .001 level. (This result appears slightly contradictory to that of (iii) above, but may be associated with the increased degree of curvature involved. The curved dials referred to in (iii) had an arc of only 54° as distinct from 180°.)

(f) *Range of dials*

One of the experiments involving an extensive range of dials was duplicated, using negatives, *i.e.*, white on black instead of black on white. The results were not only qualitatively but even quantitatively identical (no sectional differences even approached significance).

Hence it may be confidently expected that the general results listed above for "black-on-white" apply also to dials printed "white-on-black".

CONCLUSION

The main purpose of this study was to investigate possible procedures, and to prepare methods of dealing with the special difficulties which might arise. These have only been briefly outlined here, but more detailed information is available on request to others who may be concerned with similar investigations.

However, certain trends in the results appear quite definite, and would appear to afford a reliable basis for the design of certain features in dials. Other observed tendencies, while suggesting possibilities, need further experimental checking.

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Retention of Theory as a Criterion of the Need to Reconsider the Theory Content of a Practical Course

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EVALUATION of training courses, including investigation of the relevance of training for the job for which it is being given, is one of the problems which have lately been occupying the attention of Admiralty psychologists. In the case of a maintenance rating such as the Electrician's Mate (EM), it is not at all evident that the skills he is taught, including competence at theory, will be similar to the skills he uses on the job. This is because there are many different equipments that require continual maintenance, and many faults that can occur on each; and also because although the capabilities of an EM have been officially defined there is likely to be a lot of variation in the way in which his supervisors use him. Consequently any comments about the training that should be given him would have to be informed by a careful study of the actual requirements of the job at sea, a somewhat lengthy and demanding process, which might, after all, result in showing that the training was already well geared to the jobs for which it was intended. The study to be described was an attempt to determine whether such a comprehensive field study was desirable with respect to the theory content of EM2* courses.

In 1951 a Naval working party asserted that Electricians' Mates were being taught more theory than they could absorb and retain, and that in consequence the course should be made less theoretical. It was decided to test the validity of this view by determining how much of the theory taught to EM2 ratings is forgotten by EM1s doing the job. On the face of it, it would seem that if the theory is forgotten it is because it is not being reinforced by being used on the job and that ratings are able to do a useful job of work without it. Hence, in default of any evidence that the theory is required to enable ratings to learn the practical skills of the job, such forgetting would lend itself to the interpretation that ratings need not be taught it so comprehensively; and that there is a good case for examining the matter more fully even to the extent of conducting an intensive job study, the more so since it is becoming increasingly difficult to supply the

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*An EM2 is an Electrician's Mate 2nd class. After 1 year, 3 months of which must have been spent as an effective working member of a ship or a shore establishment, he qualifies for the rate of EM 1st class (EM1). After 3 years he is eligible to return to a shore training establishment and take a course to fit him to be a Leading Electrician's Mate (LEM).

Naval Electrical Branch with ratings able to meet the intellectual demands of the present training courses.

PLAN OF THE INVESTIGATION

HMS Collingwood, an Electrical Training School, was chosen for the experiment on account of its relatively large throughput of trainees. A short-answer test was devised, designed to sample the theory taught to an EM2 trainee both in the Basic Theory and the General Electrics (theory and practice on equipments) parts of the syllabus. The questions were based on examination papers already in use, a detailed syllabus, instructors' and trainees' note books, and discussion with the instructors. A draft version of the test was submitted to the Training School for scrutiny, together with a schedule designed to assist reviewers in evaluating each question. Reviewers were asked to verify that each question satisfied several criteria, an important one being that the topic covered reasonably merited a question. On the basis of this draft and the comments received from the Training School a trial form of the test was constructed, tried out on four classes of EMs, amended slightly, and then produced in final version. A questionnaire also was compiled which was intended as a first attempt at discovering what the returning EM1s had actually done at sea between completing their training and returning for a more advanced course.

Ideally one would like to give such a test of the theory covered in their course to EM2s leaving the Training School, and again to the same EMs at a later date, when they had become experienced and proficient in their jobs, say at the stage when they were due to return to the School as EM1s to take an LEM's course. Unfortunately the length of time which has to elapse before EMs can return for such a course is at least three years, and then not all EMs will be recommended for it.

Because of these limitations the ideal design was not practicable, and the amount of forgetting of theory had to be estimated by comparing the scores of EM2s completing their courses with those of returning EM1s, matched with the EM2s on the basis of their ability to learn and reproduce the theory taught in the EM2 courses, as measured by the School's own Basic Theory and General Electrics examinations.

Matching was essential because those ratings who return for an LEM's course are not likely to be a random sample of all those who were initially trained, but are likely to have been selected from among the more intelligent, and presumably will have forgotten less. Hence, unless they are matched with equally able EM2s completing the course one is likely to obtain a misleading value for the difference between the amount of theory retained at the end of the initial course when given the test, and the amount retained after three or more years of doing the job have elapsed.

DETAILS OF THE MATCHING PROCESS

Each rating, EM1 or EM2, was allotted a rank order class position based on the scores of himself and his classmates in the Basic Theory and General

Electrics examinations, held at the end of the training with those sections. As the relative dispersions of the marks awarded on those examinations have changed somewhat in the three years since most of the returning EM1s completed their initial training, it was decided to give equal weight to both sets of marks in arriving at a rank order position. This was achieved by weighting the marks on each examination by the reciprocals of their standard deviations, which had been estimated from the pooled 'within groups' variances for eleven recent and previous classes, part of two analyses computed for a different purpose.

TABLE 1: STANDARD DEVIATIONS (SDs) OF BASIC THEORY AND GENERAL ELECTRICS MARKS FOR THE OLD AND CURRENT MARKING SCHEMES AT HMS COLLINGWOOD

EM2 CLASSES	SD BASIC THEORY	SD GENERAL ELECTRICS
19—29	13.3	10.4
105—115	22.5	23.0

The departures from equal weight for Basic Theory and General Electrics for classes 105-115 which would obtain from a straight summation are negligible, and in the case of the earlier classes, 19-29, are so small that a straight summation of scores was considered to give a sufficient approximation.

It was later discovered that several of the EM1s had been initially trained at another Establishment at Chatham, but as on investigation the test appeared to be equally applicable to the training given there, it was decided to include their results in the experiment as a separate group. Accordingly they were matched with EM2 ratings who were completing their training at Chatham.

TABLE 2: STANDARD DEVIATIONS (SDs) OF BASIC THEORY AND GENERAL ELECTRICS MARKS FOR THE OLD AND CURRENT MARKING SCHEMES AT CHATHAM

EM2 CLASSES	SD BASIC THEORY	SD GENERAL ELECTRICS
32—66*	14.25	36.18
100—103	4.33	10.59

In this case the departures from equal weight would be quite serious if one merely summed the marks for the two examinations. Scores on Basic Theory were therefore multiplied by a conversion factor of 2½ and the converted scores added to those for General Electrics. The fact that the conversion factor for the old and current classes was the same was quite fortuitous.

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*The scores of these classes were not all examined: eight were chosen at random.

When each rating had been allotted a class position it was turned into a standard score in order to be able to match with each other ratings from classes of different sizes (Fisher & Yates, 1930, p. 66). For instance, a rating who came third out of a class of eight might be matched with one who was eleventh out of thirty-three.

The assumptions made in matching in this way are that each class has an unbiassed share of ability; and that although differences between classes exist, they will not be greater than would occur by chance. One is also assuming that despite minor changes in the method of presenting the course in the last three years, a rating would be equally likely to be able to answer the questions on the short-answer test after either training course, past or current.

The specially produced test, designated SP Test 210, and the questionnaire were given to all EM1s returning to *HMS Collingwood* for LEM courses between January and July, 1953, and the test alone given to all ratings completing EM2 courses at *HMS Collingwood* and at Chatham during that period.

RESULTS OF THE ADMINISTRATION OF SP TEST 210

A comparison was made of the scores of five recent EM2 classes at Chatham and five at *HMS Collingwood* on SP Test 210. It was found that no statistically significant difference between the scores of ratings at the two Establishments could be detected. As ratings are allocated at random to these two Establishments for training it was felt safe to assume that each was given virtually the same training as far as the syllabus covered by the test was concerned, and that it would be appropriate to pool the results of the comparisons between matched pairs of ratings from each Establishment. EMs from each Establishment were treated separately for the purposes of matching.

It was found that the returning EM1s did worse than the newly trained EM2s on all but thirteen of the seventy-four responses demanded by the test. The content of those questions on which EM1s did as well as, or better than, the EM2s were as follows:

(1) An Ohm's Law problem (on which both groups gave an equal number of correct answers).
(2) A problem on the voltage of cells in parallel (in which there was a difference of only one correct answer).
(3) One method of reversing a D.C. motor.
(4) The effect on the speed of a motor of decreasing its field strength.
(5) The type of instrument most used in a routine insulation test.
(6, 7, 8, 9) Four questions on battery charging.
(10) The purpose of the third brush in a motor boat dynamo.
(11) The method of call-up in a sound-powered circuit.
(12) The pu[illegible] of a field-diverting resistance in a series motor.
(13) Tw[illegible]s of sparking at the brushes of a motor (a difference of tw[illegible] of [illegible]t answers).

The tests of significance establish that of these the EM1 is clearly superior on only six questions; and of these six, two ask not for 'theory' but for rules of procedure, and four demand a knowledge of the function of a piece of apparatus. Although the EM2s were significantly superior on only 37 out of the 74 questions, the fact that all the differences save 12 were in the EM2's favour makes it not unreasonable to assume that had we been able to test a larger number of ratings we might have demonstrated their superiority on these items too. The difference in total scores, 3,291 and 2,645 for the EM2 and EM1 groups respectively, means that 19.6 per cent. forgetting took place on the test as a whole, 'percentage of forgetting' being defined as:

$$\frac{\text{EM2 score} - \text{EM1 score}}{\text{EM2 score}} \times 100^{*}$$

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[*] Use of this formula has been criticised on the grounds that a measure of forgetting should have units that are comparable throughout the scale; should not be grossly affected either by the difficulty of the task or by the ability of the trainees; and that units of improvement should be comparable with those of forgetting, with a maximum possible gain of 100 per cent. It has been suggested that a better expression would be:

$$\frac{\text{EM2 score}}{\text{Max. possible}} \times 100\% - \frac{\text{EM1 score}}{\text{Max. possible}} \times 100\%$$

The criticism concerning units of improvement is perhaps irrelevant in this particular case, but as for the first two points, it does not seem that a drop from, say, 75 per cent. to 70 per cent. means the same thing as a drop from 10 per cent. to 5 per cent., in which latter case a half or 50 per cent. has been forgotten: and that one might expect a difficult item to be forgotten to a greater extent than an easy one. In any case we are essentially interested in the forgetting of what has been learned, not in the forgetting of what might have been learned.

TABLE 3: TOTAL MARKS SCORED ON THE FOUR MAIN SECTIONS OF THE ELECTRICAL TEST

	DC	AC	MOTORS AND DYNAMOS	GENERAL ELECTRICS	TOTAL
No. of questions	17	16	15	26	74
EM2 Score (N=84)	847	687	674	1083	3291
EM1 Score (N=84)	657	456	512	1020	2645
Difference as a percentage $\frac{(\text{EM2} - \text{EM1})}{(\text{EM2})} \times 100$ ..	22	34	24	6	19.6

Considering the four main sections of the test, DC Theory, AC Theory, Theory of Motors and Dynamos, and General Electrics, we find that the greatest amounts of forgetting occurred on the AC section, and the smallest on the General Electrics. This is in accordance with what one would expect on the basis of the hypothesis that ratings forget because they do not reinforce their theory on the job. Because by far the greater part of the equipment an EM meets runs off DC supplies, AC theory is least likely to find a use and is most likely to be forgotten; conversely the theory, knowledge, and rules of procedure likely to be acquired in the General Electrics training seem the most likely to find a use.

Of course one explanation of such forgetting as is found might be that ratings were subsequently employed on highly specific duties. The training might have had to be designed to enable a rating to do any of several different tasks, and naturally one would expect that when he was allotted a specific task for a long period he would forget most of the theory which was not relevant to its performance. This does not appear to have happened, however. Examination of the answers to the questionnaire on jobs done at sea shows that there are many experiences which most ratings have in common, and that nearly everyone has, in his time, been employed on tasks such as: rewiring existing lighting circuits, rewiring telephone plugs and headsets, renewing elements in radiators, testing insulation resistances, locating faults, charging secondary cells, renewing and bedding brushes in motors and dynamos, undercutting a commutator, operating a crane, hoist or winch, etc.

Whatever the reason for forgetting of theory, then, it cannot be due to a lack of reinforcement on common duties such as these. It might be because the theory, in the form in which it was given, was not relevant to these jobs, and indeed this seems to be likely. It is not easy to see how theory can be of use in doing tasks as practical as these, where what seem to be most required are rules of procedure and plenty of practice leading to practical skills, with perhaps further deployment under the guidance and control of more senior ratings.

A FURTHER EXPERIMENT AT CHATHAM

Further evidence relevant to the amount of forgetting of the theory part of an EM's course is provided by an experiment conducted at Chatham, where Basic Theory, taught to the same syllabus as that used in *Collingwood*, is examined with the Chatham R.N. Electrical School's own 75 item short-answer test at the end of this part of the course, some 9 weeks after the commencement of training. By arrangement with the School the same test was given to the same ratings 10 weeks later, at the end of their complete course. Significant amounts of forgetting took place between the dates of these two tests. This seems all the more interesting when one realises that the intervening time is spent in workshops and general electrics training, in which the ratings deal with equipments and procedures more intensively than they probably will on the job, and where, if a knowledge of theory and principles such as are taught at present is really required, one would expect the theory to be reinforced by fairly continuous use.

RESULTS FROM THE CHATHAM EXPERIMENT

Table 4 shows the scores of 55 ratings (5 Chatham classes) on their two attempts at the Chatham 75-item test.

TABLE 4: RESPONSES OF 55 CHATHAM EM2S TO CHATHAM'S OWN 75 ITEM SHORT-ANSWER TEST

	DC	AC	TOTAL
No. of questions	45	30	75
Score on first attempt (N=55)	1924	1084	3008
Score on second attempt (N=55)	1682	675	2357
Difference as a percentage: $\frac{\text{1st score} - \text{2nd score}}{\text{1st score}} \times 100$	13	38	22

These results show that between the end of the theory instruction and the experimental examination at the end of the course these ratings have forgotten 13 per cent. of the DC Theory and 38 per cent. of the AC Theory, a total of 22 per cent. of the whole. Thus it appears that forgetting sets in as soon as the theory instruction is completed. These results are very similar to those obtained in a recent American study (HRRC, 1952), where it was shown that 'over a two month span after training in electronics fundamentals, the average theory loss was in the neighbourhood of 17 per cent.', the same method of calculating the loss being used. In this case it was the intention to test the hypothesis that the presumed advantages of teaching general principles rather than specific equipments were wiped out by forgetting of the principles. It was concluded that losses of this magnitude were insufficiently great to justify any conclusion that the hypothesis was correct, and that further field studies should be conducted. Such a field study of course would be similar to that conducted at *Collingwood*, and the results of the Chatham experiment are mainly interesting for the light they throw on the *Collingwood* results.

It would appear that the amount of forgetting demonstrated at *Collingwood* underestimates the case, and that had theory been tested immediately after the end of the relevant instruction, and that result used as a base line instead of an examination at the end of the course, the figure would have been greater than the 19.6 per cent. arrived at. If one could apply the conclusions of the Chatham experiment directly to the results at *Collingwood* the total loss over the three years or so would be approximately 37 per cent., and 59 per cent. for AC in particular. Furthermore this is only 37 and 59 per cent. of what was originally remembered, itself only about 75 per cent. of what was taught.

One cannot of course legitimately transpose the conclusions from one experiment directly to the other because the questions used were not of equal difficulty or content, but the results of the Chatham study are very suggestive and strongly support the impression derived from the *Collingwood* experiment that the retention value of the Basic Theory course is low, and that of AC in particular, lower still.

INTERPRETATION OF THE RESULTS

There are two reasons for wishing to initiate some administrative action on the basis of a demonstration that theory is forgotten. The first is that ratings have to be retaught the theory when they return for LEM courses. This is not so serious a matter, for re-learning time will be less than the original learning time, and in any case not all EMs will reach LEM status. The second is the implication that the theory has not been rehearsed or practised on the job, and so in that particular form is not necessary for the job; with the further implication that the training, at least with regard to theory instruction, could be better aligned to the job as done.

However, despite this demonstration there are still sound arguments that can be adduced for teaching theory. For instance, remembering depends on the registration and organisation of the material to be recalled, and the more meaningfully the material can be organised, the higher will be the probability that it can be later recalled. If theory is not taught, the important material, say rules and procedures, may be conceived of as a number of isolated unrelated facts, and so be poorly remembered. Again, it might be claimed that it is more economical to teach theoretical principles which could be applied in any situation, rather than rules and procedures which would relate only to specific tasks.

Although it must be agreed that some theory is necessary to give ratings a meaningful organisation into which they can fit those rules and procedures which they must learn whilst training, or acquire on the job, it must be questioned whether to achieve this end theory need be taught and examined in such detail as at present, and whether too much is not being expected of the ratings available for this training.

It must also be questioned whether the argument about teaching principles applies in this particular case, in view of the lack of marked intellectual ability,* or bookish interests in the rating in question, and moreover many ratings have in fact done their everyday jobs without using principles, either because they have not learned them in the first place or have subsequently forgotten them. Furthermore, the questionnaire results seem to indicate that as well as highly specific tasks which are probably best learned

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*The range of ability (10-90 percentile) among EM2s corresponds approximately to an IQ range of 100-125 (median 111), *i.e.*, a range of 1.5 S.D. above the mean for the general population.

on the job at sea, there is a large core of duties on which all EMs are employed sooner or later, and for which specific rules and procedures might well be taught.

To demonstrate more forcibly that a much less theoretical training for EM2s would give as satisfactory results as the present course in preparing them for their jobs, one would need to train two groups in parallel, one on the present training course, the other on an experimental course. Both should then be tested on a sample of their practical tasks rather than be assessed on their competence at theory as at present. In default of such an experiment, despite the number of questions this study has left unanswered, it can be claimed that the present course is not entirely beyond criticism. There are certainly good grounds for investigating further the relationship of the present training to the job done, starting with a detailed study of exactly what an EM's job entails.

When one has obtained a good picture of the range of day-to-day work of EMs and, very important, how they do it, one might then be able to put forward rational suggestions as to what the ratings should know thoroughly and be able to apply. It would probably be reducible to a set of rules and procedures. Unfortunately, such a study in itself would not be very helpful in deciding how long the theoretical training should take in getting these across to the ratings, nor what other topics might have to be covered in order to give these rules and procedures some meaning and coherence.

As a first approach to a well designed course one could obtain from persons with considerable experience in the teaching of electrical theory to ratings of this standard, an estimate of the time that would be required to teach the identified essential rules and procedures, plus whatever background information would be necessary to obtain and hold the ratings' interest, and to give them an organisation of theory into which they could fit and relate, and so better acquire and retain, those rules and procedures that are important. The ultimate criterion of redundancy of theory, either for such a course or the current one, will be whether the practical rules, skills and procedures required can be given a high acquisition and retention value in an organised body of knowledge less in extent than that now given.

The practical benefits of such a course would lie in the training time saved and the slight relaxation of the standards of intellectual ability and educational attainment that are required at present from Electrical Branch ratings.

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An Occupational Classification for Use in Vocational Guidance

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INTRODUCTORY

THEORETICALLY, in giving vocational guidance one could assess the characteristics of a 'client' and then match them one by one or as a pattern against those needed in various jobs to find the best fit. But jobs are so many, the characteristics of people so diverse, that this is impracticable. Our approach, on which a preliminary note has appeared elsewhere (McKenzie, 1952), is to select certain important characteristics of people actually in jobs, and on these base our grouping of jobs. Assessing the client in similar terms leads one to the relevant area of classification, so reducing choice to jobs that are definitely feasible for him. Within this range, choice will then depend on other factors, including such local considerations as which jobs are actually available in the district, what kind of workmates he will meet, idiosyncrasies of firms, and even of foremen, and so on.

Thus the first aim is to make a 'Search List' which provides worthwhile job suggestions all within the client's range. It must be easy to use, it must narrow the search without blinkering the user, it must be psychologically sound. It must aim not at solutions, but suggestions. At the same time it should fit into or be easily adapted to existing vocational guidance methods so as to make the fullest use of all the material available.

CHOOSING CLASSIFICATORY 'DIMENSIONS'

There is some agreement on characteristics that differentiate people in a way useful in guidance. Thus Rodger's seven main points (1939, p. 259; 1952), Bingham's nine points (1942, p. 94), and Super's 'psychological' facts and 'social' facts (1949, pp. 6-7), all cover much the same ground. The headings are roughly: intelligence, educational attainments, aptitudes, interests, personality traits and attitudes, general 'circumstances' (resources, responsibilities, ambitions, family and cultural background, etc.), and physique. In selecting 'dimensions' from these for our basic grouping of jobs, six criteria are suggested. Each 'dimension' should:

1. Have a precise, easily communicable definition.
2. Be reliably and economically measurable in clients.
3. Be similarly measurable in people in various jobs. If a test is used, it must (a) be easily administered to groups of people in different jobs, often under primitive conditions, and (b) be comparable with

tests of the same dimensions used elsewhere, so as to build up occupational norms.

4. Differentiate people in different jobs or groups of jobs.
5. Be relevant to satisfactory job performance or stipulated for entry.
6. Persist in the client, unless needed only for entry.

These criteria raise problems we have space only to mention, such as the familiar one of criterion of 'satisfactory' performance; and the possibility that success depends on similar basic qualities in many different jobs; or that it may depend less on the man than on his relationship with his workmates, or his supervisor, for perhaps in peace, as in war, there are no bad regiments, only bad officers. Leaving these on one side, however, we may now go on to check possible dimensions, somewhat summarily perhaps, against our criteria. (See Table 1, below.)

General Intelligence

1. This can be suitably defined and forms a continuum.

2. It can for our purpose be reliably and cheaply measured in clients.

3. It can be measured in the field, too; some occupational scores are already available.

4. Intelligence test scores differentiate between groups or levels of jobs, less well between individual jobs. Mean scores of occupational samples do fall into a hierarchy (*e.g.*, Cattell, 1934; Super, 1949), but may differ from one another by very little. Thus 15 points of raw score (test maximum 60) can cover the means of 17 occupational samples (Lingwood, 1952). Also, scores in a single job may range as widely as from the 20th to the 90th percentile (Vernon, 1949), so that ranges, even inter-quartiles, overlap considerably (Cattell, 1934). These wide ranges might be due to grouping scores of people who nominally do the same job, but actually have different scope, responsibilities, or degrees of skill. They occur so regularly, however, that the hypothesis is doubtful. At the moment, certainly, intelligence test scores do not differentiate jobs so precisely that a client's score can do more than point to a fairly wide area of jobs.

5. Correlations between intelligence and training criteria are often high (Vernon & Parry, 1949). Sometimes this simply shows how much theoretical or abstract material is included in the training (Jenkins, 1946); relevance of intelligence to the actual work is hard to prove. Thus, although Wyatt (1929) showed that while the more intelligent girls of his group disliked certain repetitive work and the less intelligent liked the same work, yet output of the brighter stayed above the average, that of the duller stayed below. It can be argued that if a person's score is much higher than the job requires he will need other incentives like promotion prospects, high pay, etc., to prevent his becoming so dissatisfied that he leaves. The argument for 'streams' in schools has some similarities. This consideration would imply a relevant upper limit of intelligence, not so much for doing the job as for staying in it. On the other hand, as Super (1949, p. 103) points out, a score above a certain minimum for the job does not necessarily pay corresponding dividends in the form of better performance.

It may be supposed too that a person will 'adjust' best where the mean score of fellows resembles that of his own, but evidence outside school is scarce. If the score is far below the occupational mean he may find it hard to compete for promotion, perhaps even to do the job. But the occupational mean found is not necessarily the optimal nor the minimal score for the job. Unger & Burr (1931) showed that many jobs can come within the reach of girls of the lowest intelligence. If they are suitably trained and have no personality difficulties, girls with a mental age of six years, for instance, can successfully do light factory or domestic work. In any case the range of intelligence found in many jobs is so wide, and often reaches so low that clearly intelligence is at best only one factor in success. Super (1949, p. 103), commenting on the lack of research into the relation between intelligence and success in higher professions, in skilled trades and in unskilled occupations, suggests there would be a positive relation in the first two and none in the last, but says 'this is still an unverified hypothesis'.

6. Tested intelligence is relatively constant over the ages involved, *i.e.*, from 15 years onwards.

Summing up, intelligence can be suitably defined, and assessed reliably and cheaply. It differentiates groups of jobs; a certain minimum for the job may be a factor in success, especially in intellectual work, or where training is intensive; intelligence persists. Some occupational data already exist; they show intelligence found. Minimum intelligence *required* is usually a function of the time available for training. Fuller validation is possible. General intelligence, then, is a possible basic dimension, if used cautiously and along with others.

Educational Attainments

1. The general level of attainment can be usefully defined by certificates won, type of curriculum, duration of schooling, consistency of progress, scores on attainment tests, or by combinations of these, and can be made into some kind of continuum.

2 and 3. In such terms it can be assessed in clients and in the field.

4. Attainments required differentiate between groups of jobs, less well between individual jobs. Use of standardised tests can improve this (*e.g.*, Lingwood, 1952).

5. Attainments are believed relevant in many jobs, subjects or groups of them being quoted as important; relevance to the actual work of scores on standardised tests can be validated (Vernon & Parry, 1949). What is critical in guidance, however, is quite often the entry level stipulated or accepted, even if this serves simply to raise the status of the job, or to limit entry, without being related to the actual work at all.

6. A certificate gained is gained for ever, but 'residual ability' in terms of attainment test scores may change considerably after leaving school (Wall, 1944). With reference, then, to jobs where 'nominal level' only is involved, attainment level persists; where 'residual ability' is involved it may not persist.

Summing up, general level of attainments seems useful as a basic dimension; it is already used as a main criterion in many fields of selection.

Special Aptitudes

1. 'Aptitudes' can be clearly defined only as test scores.

2. 'Tested' aptitudes can be reliably assessed. Being so specific, however, several tests may be needed, adding to time and cost.

3. Assessment in the field is costly; few useful data are ready to hand.

4. Some, especially the *v:ed* and *k:m* groups, do differentiate jobs usefully (Vernon, 1950). As Vernon remarks, others are too specific for vocational guidance, though useful in selection.

5. Some are known to be associated with success in jobs, but wider validation is needed. Apparent relevance suggested through 'naming' may be spurious.

6. 'Aptitudes' persist well enough for our purpose.

Summing up, many aptitudes are very specific; occupational validation in this country is scarce. Aptitudes cannot yet offer a basic classification, but may be useful within classes or levels, or to confirm eventual choice.

Interests

This word is used to mean so many different things, and the notion in general is so closely connected with such factors as abilities, environment, education and emotional needs, that any full discussion would be lengthy.

1. 'Interest' as a psychological concept is hard to define (Berlyne, 1949; Vernon, 1953). We may perhaps confine ourselves to 'interests' as usually spoken of in vocational guidance. Here interests in the sense of 'specific interests' can simply be indicated—woodwork, cycling, etc. Taken singly, however, these rarely have direct counterparts in jobs; moreover a person's specific interests are often limited by experience and opportunity, while their actual content may mean less to him than the friends, status, etc., involved. Specific interests, in short, may not show 'what he is really after'. As a result stress is usually laid instead on his underlying pattern or type of interests. Such 'types' can be identified on *a priori* grounds. Various 'interest factors' have also been statistically isolated, *e.g.*, 'scientific', 'system', etc. (Super, 1949, p. 381; Eysenck, 1953), but naming of these has to be very tentative. In any case, the interest 'type', 'pattern', etc., of a client, and also the 'types' of interest involved in jobs, are difficult to identify except in terms of an agreed test. Strong (1943) makes his approach to this by showing that people in different jobs make characteristically different patterns of responses to items on his Vocational Interest Blank. A particular client's pattern of responses may then be typified as resembling that of dentists, bankers, etc.; the actual 'interests' or 'types of interest' need not be named at all.

2 and 3. One may assess interests (Super, 1949) as *Expressed*—'he likes, dislikes, or is indifferent to' a given activity; as *Manifest*—inferred from how he actually spends his time; as *Tested*—achievement in, or knowledge

about, various activities; as *Inventoried*—the pattern found from a standardised and validated questionnaire (Strong, 1943; Kuder, 1949). (Sometimes, too, Expressed, Manifest and Tested aspects are taken as a continuum of *degree* of interest.) Expressed specific interests tend to be unstable, although giving interview leads, while it is hard to tell how far a Manifest interest is a function of opportunity, parents' income, etc., *i.e.,* how far it shows what a person would be interested in if he had a wider choice. Similarly Tested interest is a function of intelligence, education and opportunity. 'Inventoried interests', however, can be reliably assessed. Unfortunately some Inventories are laborious to score, except by machine; material is expensive; no such Inventory has been validated in Britain.

4. 'Inventoried interests' do differentiate jobs, in that responses of people in different jobs differ. Interests assessed in other terms look as if they *must* differentiate, but validation is hard to find. In differentiating jobs by the type of activity involved (rather than by the interests of people in them) so as to link with the type of interests the client has, various difficulties arise. One is how to limit the number of possible groups; another is how to decide—'from the outside'—what the main activity is in jobs which involve several. Some jobs, too, seem to call for different interests at different stages; an engineer may at first do practical work, advance to drawing office and technical studies, graduate to costing and estimating, and finally, as a manager, handle many human problems. Thus the Committee on Education for Management (1947, p. 20) found in one survey of professional associations that 70 per cent. of men who originally qualified as engineers or accountants engage later in some managerial function. Another difficulty in *a priori* grouping is seen in a study by Thurstone (1932) who analyzed 18 of Strong's occupational scales (each built on the responses of people in the given occupation). He found four factors which he named interest in science, language, people and business. Taking only three of the scales the loadings were: Doctors: science +.71, language +.33, people −.26, business −.09. Teachers: +.36, +.15, +.68, −.22. Psychologists: +.77, +.47, −.04, −.28. *Prima facie,* all these jobs involve a marked interest in people, but evidently not in the same terms.

5. As for relevance of interests to jobs, it would have to be shown that entrants with certain interests do the work better and/or enjoy it more than entrants with other interests, and also that they do certain jobs better than they do other jobs. Evidence of this kind is obviously scarce. Strong, however, finds a relation between inventoried interests and success (1943). There are signs too (Strong, 1952) that the more closely a person's pattern of responses resembles that of a given occupation, the more likely he is eventually to be engaged in it.

6. Specific interests may be unstable, especially in adolescence. Inventoried interests too may be unreliable below the age of 17 (Strong, 1943). From that age onwards, however, inventoried interests do seem to persist. Thus the correlation between scores on Strong's 'engineer' scale, taken at the university, with scores one year later is 0.91, with re-test nine years

later 0.77, and nineteen years later 0.76 (Strong, 1952). Even so, the older a person is at first test, the more likely are test and re-test to agree (Strong, 1951).

Summing up, interests are hard to define and objective measures in this country few. Even when using occupationally validated inventories extrapolation beyond validated jobs must be cautious. Interest in the sense of drives and emotional needs is clearly important, but just as hard to validate occupationally. Lacking validated instruments interests cannot be used for basic classification, though offering useful leads later on.

'Personality'

1. This can be variously defined. To exclude aspects like cognitive abilities, physical characteristics, etc., is artificial but useful, but to separate, say, 'Interests' from 'Personality' is barely possible. Even so, what remains has many dimensions. Operational definition of some is possible, *e.g.*, Eysenck's two 'main dimensions' of general neuroticism and 'introversion-extraversion' (1947), or Vernon's 'dependability' and 'extraversion-introversion' (1953). Some traits discussed in guidance are in line with these, *e.g.*, 'steadiness or reliability'. Others are less easy to define, *e.g.*, 'influence over others', 'initiative'.

2. As for assessment in a client, even the agreed important dimensions involve using several tests, few of which are yet in general use in Britain. Other methods of assessing traits tend to be unreliable. A group of people can be reliably compared with each other, but it is less easy to rate a single client reliably unless against an actual job.

3. Measuring personality dimensions of good and bad workers in jobs is even harder.

4. It may be that people in certain jobs differ characteristically from those in others in respect to some dimensions of personality, *e.g.*, on the face of things, extraversion-introversion, but this awaits validation. One feels too that some of the subjectively defined and assessed traits *must* differentiate jobs, but again validation is needed.

5. Aspects of personality (as in 1 above) are believed to be relevant to success in many jobs, *e.g.*, as accounting for some variance beyond intelligence, etc., but it is not clear how much of which aspect is needed in which jobs. Certain traits do appear relevant to success. Some unfortunately seem relevant to all jobs, *i.e.*, do not differentiate; Vernon's 'dependability' would *sound* like an example. Behaviour too depends partly on the context; *e.g.*, on group pressure to arbitrary norms of output; the impact of the group in shaping attitudes and motivations; the type of supervision; lack of definition of one's role or status; implications for behaviour of the technological process; and so on. Performance in any job depends not only on the person's traits, and of course his intelligence, aptitudes, etc., but on the interaction of these with the characteristics of the situation, the role he is given, etc. Considering how unreliable is the assessment of many traits, validation of their differential relevance to jobs is bound to be especially difficult.

6. Aspects of personality do persist. Since, however, behaviour is partly determined by actual job conditions, the range of prediction is clearly limited.

Summing up, personality, even in our restricted use here, has in itself many dimensions. Objective measurement of some is possible, and occupational studies have started (*e.g.*, Heron, 1951). At present, however, we cannot make a basic classification of occupations in terms of personality traits.

Circumstances

This refers to a person's 'general context'; points that arise include: How long training, or even delay in picking a job, can he afford? How important will his wages be? Will his family back him up? Encourage him through his apprenticeship or classes? Will they worry about status? Will tensions in the family upset his work? What are the jobs of relatives and friends and their attitudes towards them? What are their ambitions, values, standards? It is clear that many factors are involved, acting upon one another, counter-balancing one another in complex ways.

1. For our purpose these factors are important in so far as they affect choice of job. It may be possible to consider them as a single complex 'dimension', in such terms as 'Background Support'—how much, or how little, he can rely on outside of himself. Points on a scale may be sufficiently clearly indicated by general statements combined with examples.

2. Some aspects of the 'dimension' can be reliably assessed, *e.g.*, economic ones. Others, like stability of the family group, parents' values and standards, involve difficulties, yet are familiar and in fact regularly assessed for various purposes. The more time available, however, the more chance there is of reliable assessment.

3. Similarly this 'dimension' is hard to measure in people in jobs, although certain aspects can be reliably assessed.

4. The 'dimension' does differentiate broad groups of occupations. The economic aspect is often critical, though losing its importance in many jobs. It remains true, however, that entrants need better Background Support in some jobs than in others.

5. 'Background Support' is often relevant to satisfactory work, to judge from statements by foremen and others; its importance, in one form or another, is stressed by various authorities (*e.g.*, Wilson, 1945). In guidance it is certainly relevant; often a single aspect may make it critical, *e.g.*, cash for living costs while training. On the whole it is most often relevant to entry into, or during training for, a job.

6. Some aspects persist or can be predicted; others are unpredictable.

Summing up, the 'dimension' Background Support is difficult to validate occupationally, but seems to differentiate broad groups of jobs, and is usually persistent enough for our purpose. In our society its relevance to guidance, if not to performance, is hard to dispute; this alone probably makes it an essential dimension.

Physique

1. Physical measurements can be precise (height, weight), but are rarely relevant. Operational definitions of 'physique' are unwieldy and often impracticable—e.g., 'can lift *x* lbs. through *y* feet *z* times a day'. 'General health' too is hard to define except as lack of apparent disabilities. 'Unfitness' can be defined by specific disabilities; these may exclude or 'bar' particular jobs, *e.g.*, 'not fit to stand all day', rather than lead to positive suggestions.

2. A general estimate of a client's health can be made and disabilities noted as 'bars'.

3. Similarly workers in jobs can be assessed physically in rather general terms and disabilities associated with low success noted. Emphasis is usually on negative statements.

4. Physique sometimes differentiates jobs, but most need moderately

TABLE I

	INTELLIGENCE	ATTAINMENTS	APTITUDES	INTERESTS	PERSONALITY	CIRCUMSTANCES	PHYSIQUE
1. Precise definition	Yes	Yes	Yes, as factors	Only by inventory	A few traits have	Cumbrous	Negatively
2. Assessed reliably, cheaply, in clients	Yes	Yes	Reliably; not cheap	Yes, by inventory. Not cheap	Not yet	Some aspects, others difficult	Negatively
3. Assessed reliably, cheaply, in the field	Yes	Yes	Reliably; not cheap	Yes, by inventory. Not cheap	Not yet	Some aspects, others difficult	Negatively
4. Differentiate jobs	Broad levels only	Broad levels only	Most too specific	*A priori* exc. by inventory	Not yet	Broad groups only	A few
5. Relevant to success	In some jobs, especially to training	In some especially to entry	Hard to validate	*A priori* mainly	Not yet	Relevant to guidance	Sometimes
6. Persists	Yes	'Nominal' yes; 'residual' may	Yes	Inventory yes, over 17 years	Aspects do	Some aspects only	Yes
Useful later	Possibly	Yes, e.g. specific subjects	Yes	As 'leads'	Yes	Yes, in detail	Yes, bars may be critical

Characteristics of people checked against six criteria to select dimensions for a basic classification of occupations for vocational guidance purposes active, healthy people. Some 'bars' do differentiate; *e.g.*, colour blindness does not debar from all jobs.

5. In a few jobs general physique is relevant; single elements may be critical, *e.g.*, height for a policeman. Some disabilities too are critical, but 'bars' must be carefully validated; a bus conductor would seem to need all his fingers, yet one with a total of five missing is known to be doing well.

6. Physique in general terms persists; disabilities may be temporary.

On the whole, physique is not a convenient 'dimension' for basic classification. On occasion, of course, even a single aspect of it may be critical in guidance. Because stress is so often on negative statements—on 'ruling out'—it is simpler to consider physical characteristics after reaching a 'short list' of jobs.

SUMMING UP

Our list probably includes those dimensions about which most is at present known for vocational guidance. Of these, Intelligence, Attainments and Background Support most nearly meet the criteria, as Table 1 shows. With fuller occupational validation Aptitudes might come higher on the list; already the *v:ed* and *k:m* dichotomy, used cautiously, is valuable. Interests and Personality come some way behind, while Physique, however important, does not give *positive* leads. All through, however, relevance to actual job requirements is still in question, even for instance in the case of intelligence. The danger lies in stressing characteristics, less because they are essentially relevant, than because they are conveniently measurable. With these provisos in mind, however, it seems possible to use Intelligence, Attainments and Background Support, or a combination of them, to make a basic classification fit for our purpose, *i.e.*, to produce in a limited time reasonably sound job suggestions. Though these three measures probably correlate with one another over large samples, in individual cases (our main concern here) each is likely to add something new to the assessment of the client.

It is not our aim, however, simply to say how jobs *might* be classified. We must go on to the next step, which is to find the Intelligence, Attainments and Background Support actually required in different jobs. We can then rate each job, by rating people in it, in terms of these. Jobs of similar ratings can then be grouped together. Rating a client in corresponding terms leads us to a group of jobs all needing basic abilities at his level. To decide which of the jobs *of his general level* should be further considered, we must turn to other characteristics including aptitudes, interests, traits, and to our local knowledge. Such considerations need differentiate only within that level. Eventual choice thus demands more detailed study both of the client and of the job suggestions that arise. Our present discussion suggests a definite order of priority in collecting information for job descriptions and the limits of weight that can safely be put on the information thus obtained. It is hoped in a later article to describe the actual construction of a Search List in these terms, and to outline its use.

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Book Reviews

Personnel Salaries and Ratios: 1953. By DALE YODER and LENORE N. WILSON. Industrial Relations Center, University of Minnesota, Minneapolis. Reprinted from *Personnel*, July, 1953. Pp. 8. No price given.

Each year the Industrial Relations Center conducts a survey of personnel ratios and of the salaries of personnel staff. The 1953 figures were based on answers from 563 top-level personnel staff. These held 78 different titles, but nearly half of them were described as 'personnel manager' or 'personnel director'. They were working for a number of organisations in industry, commerce, public utilities and government bodies, which employed between them nearly two million people.

The term 'personnel ratio' is defined as the number of professional, technical and clerical staff employed in personnel work per hundred employees. This figure has increased from its 1952 low level: the average of all ratios for 1953 was .74, and it varied from the lowest figure of .58 for government service to 1.07 for banking. The figure for manufacturing industries was .73.

The average salary of top level personnel staff has increased 3.9 per cent. compared with 1952, but the average salaries paid varied considerably with the industry and the size of the organisation. An interesting point was that about two-thirds of those reporting received some supplementary compensation such as bonus, insurance, profit-sharing or other payments.

This factual account will be of interest to personnel managers (and those doing similar jobs under the 77 other different titles) who have much opportunity for studying conditions of employees and comparatively little chance of comparing their own conditions with those of their colleagues.

WINIFRED RAPHAEL

Handwriting Analysis as a Psychodiagnostic Tool. By ULRICH SONNEMANN. London: Allen and Unwin, 1953. Pp. x + 276. Price 35*s*.

The manner in which this book is written obtrudes itself so forcefully and sustainedly on its reader that he has great difficulty in working through to the matter. This is a pity, for he gains the impression, as he thrusts his way through the jungle of jargon and turgidity, that *Handwriting Analysis* probably contains much that is illuminating and supplies many of the answers to queries raised by the uninitiated.

For example, in the chapter entitled "The Interpretative Synopsis" we find (p. 138): "Since all well-integrated states of personality structure can graphologically be defined as states of an approximate consistency of the expressive profile throughout the various layers of the structure, the more subliminal ones among the disintegrative conditions, while tending to escape a more immediate visual grasp, would still show up by way of an inconsistent distribution of emphases on either contraction or release within those areas of rating allowing of the appearance of impulses tending to escape the writer's conscious control both in terms of his self-perception and volitional processes."

Such passages are liable to irritate the reader in much the same way as he is irritated when receiving an evidently interesting letter, written in an illegible hand. A second example (p. 36): "A handwriting will be called the better integrated in a rhythmical sense the more the element of repetitiousness of the contraction-release phases in it, regardless of the strength of the contractions, appears as the product of a spontaneous flow of the impulses of movement, and the more the elements of fluctuation in it, regardless of the scope of the fluctuation, show gradual rather than abrupt changes. To determine the degree of regularity even simpler rules evolve from the general analysis of the contraction-release cycles made at the opening of this paragraph." This passage occurs near the beginning of the book when Dr Sonnemann is stressing the importance of treating handwriting *as a whole*. The phrase "even simpler rules" proves, in this context, extraordinarily frustrating.

The persistent reader will, however, find much that is rewarding. He should finish the book with a reasonably clear conception of Dr Sonnemann's technique and of the main differences between it and alternative methods, of which he is critical. These others include, at one extreme, the "intuitive and impressionistic" approach which "since it does not involve any systematic controls, is subjectivistic to a degree of possible arbitrariness; it is, therefore, to say the least, unreliable". At the other extreme is found the exclusively statistical approach, which Dr Sonnemann deprecates as atomistic.

He emphasises, throughout, the interdependence of the various criteria, the importance of examining any given sample of handwriting as a whole whilst yet studying meticulously the separate factors, without any one of which the sum total would be altered. One is repeatedly reminded of the basic Gestalt principles: the whole being different from, and more than, the sum of its parts; its dynamic figure-ground relationship; the 'goodness' and 'poorness' of certain gestalten, the graphological criteria being both internal and external, both intuitive and logically analysable.

This last point links with a somewhat disturbing feature of the book: the frequent juxtaposition of value judgments with factual judgments, as though they were similar in kind. For example, in "Twelve Lines from Joan" (p. 146) we find: ". . . these variations never seem to lead to any 'clashes'; and the reason for this is not only that the combining movements 'negotiating' between them are *formed* with intelligent graciousness and that their freely flowing roundness seems to attain a particularly high degree of background involvement, but that the stroke itself seems to adapt itself to their conflicts . . . its doughiness never has the quality of 'formless' sensual indulgence but is consistently modulated, consistently 'plastic'—weaving, as it does, even the most impetuous pressure impulses into an imaginatively enlivened tissue of darker and lighter shades which intricately, almost playfully, seem to interact with the background -involving formal qualities of this handwriting". And again: "The quantitative extension of the movements is well-measured . . . the speed is good without being hurried." Thus ethical and aesthetic judgments are freely interwoven with technical explanation and interpretation.

There is a marked tendency too to equate the figurative with the literal; for instance, "upper" [zone] with "spiritual", "economy" [of note-paper, of space] with economy of money and time. This, however, is less exceptionable; moreover, it is stated quite explicitly (p. 41): "In symbolic experience, 'big' and 'important' are interchangeable terms, as are 'small' and 'negligible', and such expressions as 'greatness' and 'grandeur' in their figurative usages, 'magnanimity', a 'grand gesture', a 'narrow' mind, all betray the same general complex of associations. Size, therefore, is graphologically taken as a measure of the person's spontaneous self-estimate, of his feeling of self-importance. . . ."

Dr Sonnemann does not ignore some of the more general objections raised to graphology. He considers, for instance, the question of national and cultural influences in forming individual handwriting. In his opinion it is desirable though not essential that the graphologist should be informed of the writer's "original national school pattern, his social background and specific type as well as total level of education". He points out that the graphologist should not only be acquainted with the "'collective' characteristics of national and supernational handwriting patterns . . . but should understand [them] in their psychological connections with trends of the culture". Other criticisms, such as the alleged freedom of writers to produce whatever handwriting they choose and the extreme variability claimed by some for their writing, he convincingly refutes on the grounds that the handwriting qualities with most significance are not obvious to the untrained eye.

Handwriting Analysis contains a great many illustrations of sample handwriting—of the normal and the abnormal, of the eminent and the obscure. These examples, with their accompanying comments, form perhaps the most interesting pages in the book.

A. W. HEIM

The Conception of Disease: its History, its Versions and its Nature. By WALTHER RIESE. New York: Philosophical Library, 1953. Pp. 120. Price $3.75.

The title of this book is self-explanatory. The author is concerned with a philosophic analysis of the various conceptions of disease, for example, the Stoic, the Cosmological, the Physiologic, the Ontologic. The main thesis is that these conceptions do not arise just once but, in history, are omni-present, and that in successive stages of civilisation, one conception arises with greater power. The moral follows that, at any one point of time, those who are concerned with treating disease should pause to examine the deeper implications in the practice of their profession.

The appeal of the book will, though not necessarily should, be limited. This in many ways is regrettable, for what the author has to say he says directly. The treatment of the subject is, however, a condensed one. What is after all a slim volume contains sixteen very short chapters. For example, the chapter, The Psychologic Conception of Disease, is little more than three pages in length. Such a presentation then presupposes in the reader a familiarity with modes of philosophic thought which most professional men, through lack of time, inclination or training, have not acquired.

V. W. WILSON

Outline of Executive Development. Compiled by LEE STOCKFORD. Bulletin Number 23. Pasadena: California Institute of Technology, 1953. Pp. vi + 46. Price $2.00.

A quite cursory inspection of management publications both in this country and from the United States is sufficient to show that 'executive development' is one of the central topics of current interest. A slightly less cursory inspection will show that the majority of the published work tends to be platitudinous, scrappy, speculative rather than empirical, and that it is on the whole pretty unhelpful. There is at least one notable exception to this general rule, but this is not it.

The word 'outline' in the title is significant; the material presented was used as a basis for discussion at a conference on executive development, and this is really 'a conference leader's outline'. Those who know the jargon will realise that this means a list of lists—leavened with an occasional statistic or two—and rounded out with some fine-sounding definitions. No doubt the conference was stimulating and valuable to the participants, but this record of their deliberations seems to be an attempt to put a girdle round the whole of administrative theory in 46 pages, and as such it is, of course, doomed to failure. The headings in the lists range from 'Basic principles of organisation'—*i.e.*, authority and responsibility, unity of command, span of control, etc.—to 'Mendelian laws of dominance and recessiveness'; from 'Primary goals of value in the area of psycho-social development of the individual' to 'Impact of tax laws on executive salaries'. It would be unfair to suggest that there is no discernible thread of logical continuity in the series of headings, but the thread is remarkably ravelled. Some harsh things are said—in the course of one of the lists—about the danger of specialisation in education, and this series of lists seems to be a pretty striking example of the incoherent, inconsistent consequence of narrow 'specialism'. There are economists' lists, psychologists' lists, population statisticians' lists, political philosophers' lists, and personnel managers' lists. The result is diffuseness, repetitiveness, inconsistency and 'lack of closure'.

Where the outline breaks away from the attempt to regard the phrase 'executive development' as a catch-all for 'any ideas about any sort of administrative problem', and gets down to the question of the recruitment, selection, training, appraisal, promotion, and compensation of administrators (or executives, if you prefer the American term), it lists with reasonable clarity a number of suggestions drawn from the current—but largely untested—practice of progressive concerns.

There are a few howlers; for example, the "Principal Characteristics of Ratings" are listed as '1. Validity 2. Reliability', when as every social science undergraduate knows the principal characteristics of ratings are (1) dubious validity (2) considerable unreliability. But this sort of thing has a naïve charm. The reader can entertain himself too in attempting to conjure up mental pictures of the participants at the conference.

There are the pleasing group of characters who have such a marked talent for stating the obvious in well-rounded phrases. There are the characters who have the single *idée fixe* and who are determined to get it listed somewhere. There are, too, the quiet types who enter the discussion rarely, but when they do there is a flash of insight, the start of a stimulating series of reflections which produce, in this reviewer at any rate, an almost irresistible desire to hew out an experimental design to test their conjectures.

Those who are dissatisfied with the quality of the articles in journals and who are looking for a clear and comprehensive exposition of methods of developing executive talent with an abundance of examples should read *The Growth and Development of Executives* by Myles L. Mace (Harvard : 1950, price $3.25).

Those who have read Mace's book and the American Management Association's Handbook *The Development of Executive Talent* (reviewed in this journal, 1953, **27**, 1) might read this 'Outline' with profit. Post-graduate students in the social sciences looking for a thesis topic might find some interesting research propositions here.

Those who start their reading on 'executive development' with this publication are likely to decide that it is just another 'gimmick' and pursue the matter no further.

JOHN D. HANDYSIDE

A Psychological Glossary. By D. C. FRASER. Cambridge : Heffer, 1954. Pp. vi + 40. Price 3*s*. 6*d*.

This short series of notes was originally produced to assist adult extra-mural students of psychology of the University of Cambridge. The intention was to provide something more than dictionary definitions of some of the terms most frequently encountered in psychological discussion, to assist students to benefit from their text books and lectures. The book has some two dozen headings, each being afforded a fairly systematic explanation, some being illustrated with examples and enlivened by the mildly partisan comments of the author.

The choice of topics appears to have been based largely on the author's personal interests, which are very much in the field of learning theory—conditioning, fatigue, inhibition, skill, stress—with the addition of a few topics which could hardly be excluded from a glossary intended for laymen—intelligence tests, psychoanalysis, and the difference between psychology and psychiatry. As a guide for the adult student the book may be commended for its lucid treatment of several important concepts in the skill and learning areas, but the discussion of psychometrics is irritatingly and unfairly patronising, and some adult educationists may view with alarm the apparently circumscribed syllabus envisaged by the author.

JOHN D. HANDYSIDE

Personality Tests and Assessments. By PHILIP E. VERNON. London : Methuen, 1953. Pp. xi + 220. Price 18*s*.

Here is yet another remarkable display of Professor Vernon's erudition, and of his talent for presenting his facts and opinions with exceptional verbal economy. This latest book will very quickly take its place in the libraries of occupational psychologists beside its predecessors, *The Measurement of Abilities*, *The Structure of Human Abilities*, and *Personnel Selection in the British Forces* (which Dr Vernon wrote jointly with Dr J. B. Parry). Whether it will prove as useful to the non-psychologist as to the psychologist is doubtful, because its conciseness may make it hard for him to understand and easy for him to misinterpret.

Some of the chapters cover much the same ground as Dr Vernon's pre-war Industrial Health Research Board report, *The Assessment of Psychological Qualities by Verbal Methods*; but the greater part of the material is quite new, and the whole is thoroughly documented with references to literature published only a few months before the book itself. The introduction gives a survey of relevant theory, with special comments on factor-analysis and type-psychologies. The reader who tackles it seriously will have to do a good deal of further study, if he is to derive full benefit from Dr Vernon's pithy summaries and comments; but that is what he is meant to do, and he will find the task a rewarding one. In the next chapter the author discusses interviewing, and although it may be questioned whether he is wise to talk and generalise about the validity and reliability of something called 'the interview', it is clear that all the material gathered together in the chapter is very important. Then comes a chapter on physical signs of personality, inevitably thinner than the first two, and rather of the nature of a rest-pause, much needed before the three that follow, on expressive movements, simple behaviour and cognitive tests, and miniature and real-life situations. Next are chapters on ratings and judgments of personality, self-ratings and personality questionnaires, and the measurement of attitudes and interests, followed by a lively chapter on protection techniques.

In his final chapter, called Conclusions and Future Developments, Dr Vernon flings out research topics in rich miscellany. As he truly remarks, "There is scarcely a method either praised or condemned in this book which could not be clarified by further investigation. Results are so variable in the personality field that the repetition, extension, and interlocking of previous researches would be more useful than the continued construction of more or less novel tests". It is probably true to say that no book published in this country in recent years shows more convincingly than his the need for planned advance along these lines.

ALEC RODGER

Orientation et sélection professionelles par l'examen psychologique du caractère. By FRANZISKA BAUMGARTEN. Paris: Dunod, 1953. Pp. 192. 750 French francs.

The author's main purpose is to propose a new technique for measuring character traits in vocational guidance. After a short introductory chapter on the history of character examination, she goes on to discuss in greater detail the main difficulties in character testing. In some painstaking chapters she expounds some principles of character testing and testing methodology. She concludes that character and aptitudes represent different aspects of personality as a whole and both are equally important for vocational success. In assessing the whole personality the author proposes the following procedure: (1) special tests for character and interests; (2) aptitude tests to which a new standardized characterological scoring method is applied; and (3) observations during the test situation. The special tests for character and interests are Tramer's 'book catalogue test', the 'proverb test' and a 'vocational interest test'. The 'book catalogue test' is a list of 430 titles of books of general interest from which the subject is to select the 10 which interest him most. The 'proverb test' is intended to measure attitude towards work and consists of a list of 190 proverbs and statements from which the 10 favourites are to be chosen. The 'vocational interests test' works in much the same way as the 'book catalogue test'. The three tests are described minutely in great detail. The aptitude test set is intended to measure manual ability and dexterity, visualization, judgment, and what the author calls social sense. Twenty case records are presented comparing evaluations by employer and psychologist.

The book is of very great interest because it considers one of the leading questions in psychological vocational guidance. However, the value of the book is limited by the total lack of scientific validation of the method or the tests. No evidence is offered for the worthwhileness of the 'new' characterological classification. It is true that some case records are presented, but the small number of cases involved, the questionable evaluation of the results and the questionable criterion allow no valid conclusion to be drawn. Furthermore, it seems as if the author has failed to consult most of the considerable British, American and Scandinavian literature of her subject; the few references are almost exclusively Swiss, French and German. Until the traditional methods of scientific experimentation have been applied, the character examination and testing methodology proposed by the author can only be looked upon as interesting recommendations which might or might not be useful for practical purposes.

SIGVARD RUBENOWITZ

Tables for Aptitude Testers. By A. G. ARBOUS. Johannesburg: National Institute for Personnel Research, South African Council for Scientific and Industrial Research, 1952.

These tables ought to be welcomed by every serious worker in the field of personnel selection. They are extremely well produced; they have a complete explanatory text on their use; and they contain more information than any other probability tables of the same kind that have appeared hitherto.

The mathematical theory behind them does not involve any new principle. It is concerned chiefly with the determination of the proportion of the total population who are both selected and successful, given a particular validity coefficient, and the cutting scores on the criterion and on the test battery. The required proportion can be obtained by the double integration of the bivariate analogue of the normal distribution, this work having already been tabulated by Pearson. These basic bivariate probabilities are set out by Arbous in intervals of $.5\sigma$ of the test and $.1\sigma$ of the criterion (or by transposition: $.5\ \sigma$ of the criterion and $.1\ \sigma$ of the test). In addition, these tables contain the normal distribution probabilities, *i.e.*, the proportion of the total population selected or rejected at a particular cutting score on the test.

The tables also provide the proportion of the total population who are both selected and failures, the proportion of the total population who are both rejected and failures, the proportion of the total population who are both rejected and successes, the proportion of selectees who are failures, the proportion of the total population who are misfits, and the efficiency indices of the test battery determined by the gain which the test battery achieves over purely random selection in increasing the percentage of successes in the selected group. Indirectly one can also obtain the probability of success for a given class interval of the test battery.

Since the tables are symmetrical, space is economised by using the same table for the positive and negative value of a particular cutting score on the criterion. It is confusing, however, to find that the scale of test scores presented in the first column goes together with the sign presented in the last column, while the scale presented in the last column goes together with the sign presented in the first column. This, however, is only a small inconvenience which can easily be avoided by the reader who studies carefully the instructions or checks the obtained values by common sense.

A word of warning should be issued to the less sophisticated reader against a too literal acceptance of all the implications that can be derived from the tables. Under certain conditions, for instance, the reader may find that his test battery with perfect validity coefficient may have an extremely small index of efficiency as defined by these tables. This will arise when the cutting score on the criterion is very high and the cutting score on the test very low. In such a case the selector does not necessarily need to lose confidence in his test battery or in his coefficient of validity or in the practical value of his selection procedure. He may very often find greater satisfaction in reflecting on the arbitrary way in which the cutting score on the criterion was chosen. This may lead him to doubt the reality of the corresponding index of efficiency which to a great extent depends on the cutting score.

Nevertheless, provided the selector knows what he is doing, these tables may be very useful in economising the time of computation, and thus facilitating the quantification of the selection procedure. To that extent they are definitely worth having. The reviewer recommends that they should be added to the stock of manuals in the possession of every selector, unless, of course, the selector happens to be a person who knows all the answers without any statistics.

OLGIERD POREBSKI

Social Implications of the 1947 Scottish Mental Survey. By THE SCOTTISH COUNCIL FOR RESEARCH IN EDUCATION. London: University of London Press, 1953. Pp. xxiii + 356. Price 10*s*. 6*d*.

In the second mental survey (1947) of all 11 year old children in Scotland, several items of sociological information were collected on a 10 per cent. sample, namely, 7,380 children born on the first three days of each month of 1936. The present volume contains an analysis of this data, carried out mainly by Mr J. Maxwell. As one would expect of Moray House publications, it is comprehensive, clearly presented, and cautious. Over half of it consists of detailed tables, graphs and scatters. Now it is seldom that survey material, as distinct from specially planned experiments, can provide definite answers to important problems, since the relevant factors interact in too complex a fashion (this should be particularly obvious to industrial psychologists). Mr Maxwell has teased out the factors as well as anyone could; but it would be difficult to claim that the results are very enlightening psychologically. There is no fresh evidence on whether the absence of a decline in mean IQ since 1932 is due to intelligence test scores depending too greatly on environment, or to other causes. However, the very wide range of scores among children brought up in the best homes (professional fathers, scarcely any overcrowding), and the poorest homes (unskilled manual fathers, gross overcrowding), argues strongly against extreme environmentalist theories. The mean scores for these occupational classes range, as usual, from about IQ 114 to 95, and there are similar but smaller differences in height and weight which, incidentally, correlate +0.25 and +0.19 with IQ. The seriousness of overcrowding in Scotland is indicated by the fact that just over half the sample lives in homes with two or more persons to a room. Though overcrowding is strongly associated (negatively) with physique and intelligence, there is nothing to prove that the relationship is causal. Other variables which are carefully analysed include mother's age, type of area in which living (city, small town, etc.), and migration from one type to another during the child's lifetime. The first of these apparently produces no clear effects, and the second shows surprisingly little relation to intelligence, perhaps because the areas were too mixed. (Presumably it would have been too invidious to publish the differences between Glasgow and other cities, or between different parts of cities or different counties.) However, migrants *to* cities and towns average 4 IQ points higher than migrants *from*, and the difference in mean is reversed for migrants to and from 'Other Areas'. This naturally suggests that rural areas are being drained of their brightest stock; yet the overall rural mean is so far very little lower than the urban, and its physique is superior.

The volume includes also a study of the 525 pairs of twins in the total sample, and brings out, rather more clearly than much previous work with less representative groups, their low survival rate and their inferior intelligence—a mean of 95; this inferiority is not attributable to increased family size. A further volume on the educational implications of the survey will be awaited with considerable interest. P. E. VERNON

Recruiting the College Graduate: A Guide for Company Interviewers. By RICHARD S. UHRBROCK. New York: American Management Association, 1953. Pp. 31. Price $1.25.

The purpose of this pamphlet is to help industrial and commercial firms to select their graduate management trainees. The author is the head of the Research Department, Industrial Relations Division, of The Procter and Gamble Company, USA. The pamphlet is in two parts. The first is about campus interviewing of all those applying for jobs, and the second is about the more intensive interviewing at the company's premises of those considered to be serious candidates. The first part has a helpful rating scale, a check-list and a detailed question-and-answer example of a short interview. The emphasis throughout is on the interviewer being aware of what he is trying to do, on not wasting time, on exploring, although sketchily, the candidate's personal history, his achievements and preferences. Dr Uhrbrock recommends that the second stage of interviewing at the company's premises should be carried out by four or five members of the company's staff who each take an area and work at it rather intensively (*e.g.*, areas of vocational interests, of social and community attitudes, of ambitions). This, however, is little more than a suggestion as it takes up only two pages of the pamphlet.

I invited opinions from two men who spend a lot of their time in interviewing candidates for graduate management-traineeships. They both thought the pamphlet useful—although one of them had difficulty in ridding his mind of the idea of the campus interviewer lying down on the grass with the candidate. I can imagine all company interviewers, and particularly beginners, getting something of value from this pamphlet: there is plenty of sound advice and the tone is on the whole sensible. It is a pity that it is marred by the suggestion that the candidate's energy can be assessed by observing whether he slouches in the chair. Most of us would prefer N. A. B. Wilson's treatment of this topic in *Occupational Psychology* (xix, 161-179). And I don't much like Dr Uhrbrock's quoting with obvious approval Emil Ludwig's view that "the tell-tale symptoms of sincerity is a man's face, not his words".

DENIS MCMAHON

Group Leadership. By G. WESTERLUND. Stockholm: Nordisk Rotogravyr, 1952. Pp. 257. Price 16 Swedish Crowns.

The sub-title of this book, which was the author's thesis for a doctor's degree, is *Behaviour in a work situation with functional supervision and with group leaders*. The functional type of supervision is not common in England. It may result in a given worker being 'supervised' by several persons, different supervisors controlling different aspects of the work. This was the situation that Westerlund found when he was invited to investigate the Stockholm long-distance telephone exchange.

The early part of the book describes the background in considerable detail and with abundant line diagrams, tables and pictures. Some of this background information is so surprising as to be almost unbelievable. For example, the annual absentee rate of female telephone operators rose from twenty-five days in 1940 to fifty-two in 1950. Labour turnover was high and operators were reluctant to accept promotion and responsibility. The management was aware of the unsatisfactory nature of the lines of authority but was anxious to make the most appropriate of a number of possible changes. There was careful consultation at all managerial levels and explanation and discussion with the workers concerned before any experimental change took place.

The careful building up of the experimental situation is described and is a model. In some respects Westerlund found operational conditions that must make others envious of his good fortune. It was not difficult to record exact information about the telephone operators' load of work, the time taken for operators to respond to customers' calls, and similar information. The way in which this information was fed into the experiment and was related to other information was not good fortune but good experimental design. All the objective information was related to information obtained by interviews of different types. The results of the experiment are set out at some length, each aspect of the original working hypothesis being set against the appropriate findings.

The outcome of the investigation must be regarded as highly satisfactory. Management agreed that the experimental supervisory arrangement should be adopted in appropriate departments, that further investigations should be carried out elsewhere, and that the problem of selection and training of supervisors would be carefully examined.

But these 'operational' successes are not the most important part of this book. The whole methodical and painstaking way in which the problem was examined, and the experiment planned and carried out, make it an important contribution to the literature of field research in occupational psychology.

There is an additional reason for being grateful to Westerlund. He devotes one valuable chapter to a review of previous research on industrial leadership and supervision.

HARRY G. MAULE

An Introduction to the Study of Industrial Relations. By J. HENRY RICHARDSON. London: Allen and Unwin, 1954. Pp. 442. Price 30s.

Professor Richardson, who is Montagu Burton Professor of Industrial Relations in the University of Leeds, has investigated industrial relations personally over an unusually extensive range of countries, and his attempt at a comprehensive survey of industrial relations is planned mainly as an introduction, also to help define the subject.

General principles and problems are the 'essentials', and descriptive details are to be avoided.

Into this four-fold framework—relations at the work-place, collective relations, the functions of the State, and international aspects—a great mass of material is compressed and ordered. There does not seem much that is new in this material, but on the other hand it is difficult to find institutional or technical developments of any generality or importance to which there is not at least some reference.

Professor Richardson's performance merits respect. As he recognises, industrial relations is a meeting place of many disciplines, *e.g.*, economics, psychology, sociology, law, history, and politics. To attempt to gather the material under one roof even as an introduction is worthwhile, but is also very difficult. There is considerable risk of losing the force of the original data. For example, economists will probably judge that not enough emphasis has been given to productivity and its relation to real wages with the promise that this holds for outgrowing important grounds of industrial conflict. Psychologists will find inadequate emphasis on informal groupings, leadership, climates, expectation, and habit as determinants of human relations in industry. Sociologists. will require more emphasis on the enormous and increasing complexity of modern society and the insecurity that follows for individuals and classes. The effects of mass production and technical changes on skill and satisfaction in work have strongly supported claims to importance. Many will judge that the unconscious and emotional elements of many attitudes and relations in industry are not given sufficient attention.

There is considerable risk also of losing the full benefit of comparative study. Concentration on general principles amid such copious material almost imposes this disadvantage. For example, to one who has worked under the Australian system of compulsory arbitration, the treatment in chapter 24 seems hardly critical enough. The trend away from conciliation and "the growth of legalism at the expense of understanding" go far from the responsible and constructive approach to industrial relations which Professor Richardson rightly desires to foster. Again, labour relations in Scandinavia are mentioned only briefly, although time lost from industrial disputes there is now very low, and the highly centralised processes of collective bargaining and mediation provide instructive comparisons. The interesting approach in Holland to wage regulation through job evaluation is not mentioned.

In this book the term 'industrial relations' is used in several ways. The emphasis is on 'human relations in the processes of production'; 'industrial relations is the art of living together for purposes of production'; but the term is extended uncritically to cover relations between trade unions and employers' associations very far from the workplace. The union secretary facing rebellious members and the personnel manager who sees a careful human relations programme frustrated from afar by industrial conflict become aware of discontinuity and distance between these areas or levels of relations, and it seems important to make this clear. Again, 'the fundamental purpose of industrial relations is . . . securing harmonious working relations . . .' seems almost circular. It is the study of industrial relations that can be so applied. Apart from the possibility of confusing the reader seeking introduction, the terminology perhaps masks major problems. What are these relations? What are the discontinuities as well as the connections between human relations and collective relations? How does policy or action through institutions or governments affect human relations in a factory?

To sum up, the book seems stronger at institutional and societal levels than in the area of human relations which it was planned to emphasise. There is much useful material, but the difficulty of bringing it together in somewhat eclectic relation to general principles is evident.

E. P. KELSALL

The Uses and Abuses of Psychology. By H. J. EYSENCK. London: Pelican Books, 1953. Price 2*s*. 6*d*.

Anyone who reviews in the psychological field these days tends to come across quite a lot of Dr Eysenck's work. As time goes on there mingles with admiration of so much industry a feeling that one is watching the parade of a stage army. Familiar figures pass and repass, sometimes with beards and sometimes without, until it becomes very difficult to tell how many men are really involved. But they are men and not shadows. Whatever may be the size of Dr Eysenck's contribution, there is no doubt about its solidity.

The present volume may best be described as a series of essays upon psychological topics of general interest. One or two may perhaps have been included because they deal with topics upon which Dr Eysenck holds strong views. The essays are classified under four main headings: *Intelligence Testing, Vocational Psychology, Abnormal Behaviour,* and *Social Attitudes.*

Within the limits of space available the treatment of intelligence testing is remarkably clear and comprehensive. The inclusion of actual test items to illustrate primary mental abilities should be very helpful, and the whole section might well replace the chapter on intelligence in most introductory text books.

The second section is less satisfactory. After a shrewd appraisal of the difficulties facing those who would give vocational guidance, Dr Eysenck goes on to describe, in a rather perfunctory way, student selection, and the kind of things done at Civil Service boards. Finally the topics of work, productivity, and motivation are dealt with in a single short chapter, mainly by reference to a few writers whose contribution has passed into psychological history. It was perhaps unwise to introduce such important matters merely because a book on the uses of psychology might be expected to mention them.

In the third section an introductory essay, mainly on the Kinsey reports, is followed by three in which Dr Eysenck develops his sceptical objections to current psychotherapy and the theories behind it. There is no doubt that what he says here should be read by the ordinary man who has so long been exposed to a speculative clinical approach. But scepticism here can be carried too far. Dr Eysenck seems occasionally like one who refuses to accept the reports of a returned traveller on the grounds that he did not have a theodolite with him on his voyages.

The final section on national stereotypes, anti-semitism, Gallup Polls, and politics, copes very well with such complicated topics. Some of the 'managerial' ideas which creep into the chapter on politics may look rather alarming but Dr Eysenck qualifies them himself and no doubt does not intend them to be taken too seriously.

All in all, this is a lively, provocative book which makes some telling points with clarity and humour. It will represent applied psychology to a wide public, and the reviewer for one is quite happy to be so represented.

J. DREVER

Other Books Received

The following books have been received. Their inclusion in this list does not preclude their review later.

Size and Morale. ACTON SOCIETY TRUST. London: Acton Society Trust, 1953. Pp. 44. Price 3s. 6d.

Management under Nationalisation. By T. E. CHESTER and J. H. SMITH. London: Acton Society Trust, 1953. Pp. 80. Price 7s. 6d.

Irish Management. Vol. 1, No. 1, January/February, 1954. Published bimonthly. Cork: Irish Management Institute, 1954. Pp. 1-52. Annual subscription 6s. 6d.

The Personnel Administrator at the Crossroads. AMERICAN MANAGEMENT ASSOCIATION PERSONNEL SERIES No. 153. New York: American Management Association, 1954. Pp. 54. Price $1.25.

Selection for Industrial Leadership. By A. G. ARBOUS. London: Geoffrey Cumberlege, Oxford University Press, 1953. Pp. xvi + 180. Price 30s.

Psychoanalysis and Personality. By JOSEPH NUTTIN. London: Sheed & Ward, 1954. Pp. xiv + 310. Price 16s.

Construction of Esso Refinery, Fawley: a Study in Organization. By A. P. GRAY and MARK ABRAMS. London: British Institute of Management, 1954. Pp. 44. Price 3*s.* 6*d.*

Maintenance of Automatic Telephone Exchanges. PRODUCTIVITY TEAM REPORT. London: Anglo-American Council on Productivity, 1954. Pp. x + 82. Price 5*s.* 6*d.*

The Dangers of Being Human. By F. CLAUDE PALMER. London: The Bodley Head, 1954. Pp. 146. Price 7*s.* 6*d.*

Motivation and Morale in Industry. By MORRIS S. VITELES. London: Staples Press Ltd., 1954. Pp. xvi + 510. Price 50*s.*

Training and Promotion in Nationalised Industry. ACTON SOCIETY TRUST. London: Allen & Unwin, 1951. Pp. 138. Price 10*s.* 6*d.*

Problems of Promotion Policy. ACTON SOCIETY TRUST. London: Acton Society Trust, 1952. Pp. iv + 20. Price 2*s.*

Uncertainty and Business Decisions: a Symposium. Edited by C. F. CARTER, G. P. MEREDITH and G. L. S. SHACKLE. Liverpool: The University Press of Liverpool, 1954. Pp. viii + 104. Price 10*s.* 6*d.*

Married Women in Industry. By E. M. HARRIS. London: Institute of Personnel Management, 1954. Pp. 32. Price 4*s.*

Die Psychologie der Menschenbehandlung im Betriebe. By FRANZISKA BAUMGARTEN. Zürich: Rascher & Cie. 3rd edition. 1954. Pp. 408. Price Sfr. 21.60.

Method and Theory in Experimental Psychology. By CHARLES E. OSGOOD. Oxford University Press (London: Geoffrey Cumberlege), 1954. Pp. viii + 800. Price 80*s.*

Foreman, 1954. No. 2. Edited by W. H. BOWER and THOMAS FASSAM. London: Industrial Welfare Society. Pp. 1-60. Price 2*s.*

Zeitschrift für Verkehrssicherheit. Volume 1, Nos. 1/2. Tübingen: J. C. B. Mohr (Paul Siebeck), 1952. Pp. 1-96. Price D.M. 4.90.

The Human Side of the Office Manager's Job. A.M.A. MANAGEMENT SERIES No. 134. American Management Association, 1953. Pp. 40. Price $1.25.

Building Up the Supervisor's Job. A.M.A. MANUFACTURING SERIES No. 213. American Management Association, 1953. Pp. 36. Price $1.25.

Motivation: the Core of Management. A.M.A. PERSONNEL SERIES No. 155. American Management Association, 1953. Pp. 44. Price $1.25.

Essentials of Effective Personnel Administration: Case Studies of Successful Company Experience. A.M.A. PERSONNEL SERIES No. 154. American Management Association, 1953. Pp. 52. Price $1.25.

Dreams and Nightmares. By J. A. HADFIELD. London: Penguin Books, 1954. Pp. xii + 244. Price 2*s.* 6*d.*

The Technique of Psychotherapy. By L. R. WOLBERG. New York: Grune & Stratton, 1954. Pp. xiv + 870. Price $14.75.

Streamlining Office Equipment and Services. AMERICAN MANAGEMENT ASSOCIATION OFFICE MANAGEMENT SERIES No. 135. New York: A.M.A., 1954. Pp. 36. Price $1.25.

The Appraisal of Intelligence. By A. W. HEIM. London: Methuen, 1954. Pp. viii + 172. Price 12*s.* 6*d.*

Industry and the Delinquent. INDUSTRIAL WELFARE SOCIETY Broadsheet No. 10. London: I.W.S., 1954. Pp. 28. Price not stated.

Gearing up for Better Production: Organizational and Interdepartmental Aspects of the Manufacturing Job. AMERICAN MANAGEMENT ASSOCIATION MANUFACTURING SERIES No. 212. New York: A.M.A., 1954. Pp. 58. Price $1.25.

European Impressions of the American Worker. By ROBERT W. SMUTS. New York: Columbia University Press, 1953. London: Geoffrey Cumberlege. Pp. x + 62. Price 12*s.*

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Attitudes to Work

By L. S. HEARNSHAW

This is Professor Hearnshaw's Chairman's Address to the Industrial Section of the British Psychological Society. It was delivered in London on 14 January, 1954.

IN a recent contribution to Talcott Parsons' book, *Towards a Theory of Social Action,* Tolman (1952) suggested that a principal weakness of contemporary psychology was our lack of knowledge of what he called 'the belief-value matrix or matrices'. It is this lack, wrote Tolman, which is one of the reasons why psychology today is so frustrating, as I suppose we will all agree it is. "All the so-called dynamic problems of personality psychology . . . as well as the problems of the maintenance or disintegration of social systems and of cultures will be illuminated by the general concept of the belief-value matrix." This statement of Tolman's is one of a number of signs — Mace's (1953) presidential address to the British Psychological Society was another—that this question of value may be moving towards the centre of the psychological picture. As soon as psychologists have become convinced that values have a place in the world of fact and not only in the heads of philosophers, and that they are capable of being investigated by empirical means, the main resistances to their study will have been overcome, and one of the chief regulators of human behaviour brought within the framework of psychological study.

In the illumination which Tolman has suggested would follow this development, no doubt industrial psychology would share; and indeed the growing number of attitude surveys that have been carried out among industrial workers since the war is a recognition that this area of psychology is industrially important. For the study of attitudes merges necessarily into the study of values. The difficulties confronting the psychologist in these studies are indeed formidable, and even discouraging. In the psychologist trained in the precision of laboratory situations they evoke often an exasperation with which it is difficult not to feel some sympathy. How nice to be a human engineer, to deal with the concreteness of knobs and dials, and to leave the cottonwooliness of values and attitudes for academic verbalisers to cope with! Quite nice, no doubt, and comforting to the psychologist, but nevertheless, if exclusively pursued, a retreat from reality. For our subject matter is not made to order, and for a scientist even more important than precision is a determination to understand and get the measure of his subject matter. If values and attitudes are principal regulators of human conduct, then values and attitudes we must somehow endeavour to understand, or give up the idea of a comprehensive scientific psychology.

The difficulties, of course, which confront the psychologist relate not only to the tools and techniques of investigation but to his comprehension of the scope and nature of the problems themselves. In a paper last year Marriott (1953) discussed some of the difficulties in industrial attitude survey methodology and I do not intend to dilate on them. Nor do I intend to review in any detail the results of the attitude surveys that have so far been carried out. This has recently been done very fully by Viteles (1953) in his new book *Motivation and Morale in Industry*. I propose rather to consider in fairly general terms some aspects of the problem of attitudes to work which do not appear to have received as yet a very systematic treatment by industrial psychologists, though there is reason for thinking they are of fundamental importance.

I must begin by an apology for considering a topic upon which the data, such as it is, is qualitative and far from precise. I can provide you with no neat tables of results significant at the five per cent. level. This does not mean that I am unsympathetic to the insistence on more rigorous methodology, which is one of the most noticeable and notable developments in current psychological work. I do suggest, however, that this more rigorous methodology is a goal and not a starting point, and that there is a danger of seriously inhibiting the growth of fruitful new lines of enquiry if we insist in the early stages on too exacting a standard of precision. In scientific enquiry there are three main stages: firstly, becoming aware of the problems; secondly, the formation of hypotheses; and, thirdly, testing and verification. Psychology has for some time been an empirical science, devoted to the establishment and accumulation of verified facts; it has much more recently become conscious of the role of theory and hypothesis. But it by no means always adequately recognises all that is involved in the first stage of scientific enquiry, in becoming aware of the problems. There is a world of difference between significant and trivial hypotheses. An hypothesis may be testable and formally unexceptionable, but nevertheless scientifically empty. Its significance derives from the problem to which it relates. An eye for significant hypotheses is perhaps the least controllable, but one of the most important parts of scientific endeavour, as Beveridge (1950) has shown in his *Art of Scientific Investigation*. Chance may sometimes play a part in the generation of significant hypotheses, but more often an imaginative quality in the scientist himself that has not infrequently been compared with dreaming. It is in this early stage of scientific investigation that qualitative observations may be of more value than quantitative measures, which may easily miscarry for the simple reason that the hypothesis they are designed to test may have no systematic importance. Perhaps it is because psychologists in their fashionable hurry to worship at the shrine of exact methodology have shown some tendency impatiently to bye-pass the prior observational and reflective stages of scientific enquiry that the most suggestive observations on attitudes to work have come not from industrial psychologists—with the exception possibly of Mace, who is a man of many parts—but from an economist, like Zweig, an historian, like Carr, a philosopher, like Salmon, or from the mainly amateur members of productivity teams.

For on the whole the studies carried out by industrial psychologists themselves in the field of industrial attitudes have been restricted in their frames of reference. They have been concerned, broadly speaking, with three main topics. Firstly, there have been studies, numerous studies, of attitudes to *specific* features of the industrial environment, to wages and wage systems, security, status, supervision, working conditions, unions, industrial relations policies, types of job, and so on. It is these studies that have been summarised by Viteles (1953) in his recent book with his usual meticulous care. The latest development is the application of factor analysis to this attitude data, for instance by the Survey Research Centre, and the Chicago Employee Attitude Research Group. Secondly, there have been comparative studies of the sort carried out by Marriott (1951) in this country and by various groups in U.S.A., in which different factories have been compared with regard to attitudes, and an attempt made to link differences in attitude to features of the industrial situation. Thirdly, there have been studies of changes in attitudes resulting from changes in the industrial situation, both planned and unplanned. Of these the best known examples are the Hawthorne (Whitehead, 1938) and Glacier Metal (Jaques, 1951) investigations.

Attitude studies along these lines have a twofold value. They provide a knowledge of the features within the industrial situation that influence and modify attitudes, and they provide local knowledge of attitudes to this, that and the other which is of diagnostic value in troubled industrial conditions and a pointer to management. Their main limitation is that they deal exclusively, or almost exclusively, with attitudes to specific aspects of the working situation and not with attitudes to work as contrasted with other areas of life. They throw little light, therefore, on the place of work in the 'belief-value matrix' as a whole, and there are reasons for thinking that this is one of the really crucial questions.

In modern technical civilizations work has increasingly become a demarcated area of life. There is for more and more people a recognisable meaning in phrases such as 'on the job', 'working hours', 'retirement', in a sense quite unlike anything that obtains, or has obtained, in a simpler peasant or craft economy. The meaningfulness of this demarcation is not invalidated by difficulties in defining borderline cases, any more than the uniqueness of the city is disproved by the absence of city walls which precisely mark it off from the countryside. A characteristic feature of work is that it is an activity performed under obligation. The individual undertakes to carry out certain duties (this word in itself is significant) in a certain manner, and usually, though not always, to be in certain places at certain times. This is formally recognised in the contract of service, though it applies equally to all work, whether or not there is a formal contract, even to 'voluntary' work, and work which one sets oneself, such as writing a book or mowing the lawn. There are, of course, other attributes of work such as the fact that it usually implies activity continued over a period of time, perhaps a lifetime, and pursued with some regularity—odd jobs are the vanishing point of work—and also the fact that it is commonly integrated into the economic system. Nevertheless the element of obligation, though not a unique characteristic, is perhaps the most important characteristic of work. I was glad to see that John Cohen (1953) has stressed the importance of defining work in social, cultural and historical rather than in merely physical or physiological terms. I do not believe that any theory of work which does not recognise its social meaning, and in particular the element of contract and obligation which it implies, is going to prove satisfactory. I also suggest that a theory of work is basic to any industrial psychology which is to rise above the level of an empirical hotch-potch.

If this account of work is correct, then two implications follow when we turn to the question of attitudes. Firstly, if work is a demarcated area of life, this area can be evaluated in importance in relation to other areas. An individual's attitude to work will partly depend upon this evaluation. The rival claims of sport, entertainments, hobbies, sex, crime, religion, sociability—I mention them in no particular order—may be so insistent that work is regarded as a wearisome intruder. Secondly, if work implies obligations, an individual's attitude to work depends partly on his grasp and his acceptance of these obligations, and the qualitative standards of performance which serve as his norms or models. In both these senses attitude to work is a meaningful concept, and the problems that revolve around it are, I maintain, central problems in industrial psychology.

This truth has, I think, emerged quite plainly from some of the qualitative studies carried out in recent years by non-psychologists. From a scientific point of view these studies are open to many criticisms. But for reasons I have already stated they are a more fruitful starting point than many more precise researches. There is a role, as Heidbreder (1924) once pointed out, in baffling situations for 'spectator behaviour'. With some unanimity these non-technical studies have pointed to the importance of the role of attitude to work.

In their comparisons between British and American industry the reports of the productivity teams, which Graham Hutton (1953) has conveniently digested in *We too can Prosper,* make observations on differences in attitudes, in philosophy, social outlook and national customs. "One of the most obvious facts", writes Hutton, "is the psychological factor: the climate of opinion, the social environment, the morale of a people". Again, as Hutton puts it: "The hang-over of traditional, long-standing British attitudes on both sides of industry is today the greatest single cause of the average and lower than average level of performance by British management and organized labour alike". Campbell Balfour (1953) has no doubt rightly warned us against accepting these reports as scientific evidence. But if we take them as posing significant questions rather than as providing authoritative answers we can learn much from them.

Christopher Salmon's (1953) broadcasts *Prospect of Britain* had a similarly stimulating function. Speaking of British industry he too put forward the view that it was "not circumstances, but something in our attitude of mind which holds us back". And he traced the historical origins of the British attitude to work and the persisting influence of the values of an older non-industrial society. Our main need he considered in Britain today was for 'a decent theory of work'.

Then Zweig (1952a, 1952b, 1951) in his descriptive studies of British workers and in his book *Productivity and Trade Unions* brings out the importance of attitudes and their historical basis. The force of habit, the past in the worker's mind, traditional standards and ways of life, unions as repositories of collective memories, are predominant and recurring themes.

All these accounts are qualitative, impressionistic, and no doubt unduly simplified. Yet they point to two things with some unanimity, the matrix of cultural values within which attitudes to work are set, and the deep historical roots which these attitudes and values not infrequently possess.

In general, industrial psychologists have paid little attention to these matters. Adam Curle (1949a, 1949b), it is true, has written on the sociological background to incentives and 'the need to take into account the more profound factors which affect social life as a whole', and has given us an anthropological appraisal of incentives. Norah Davis (1948) in her studies of attitudes to work among building operatives has referred to the importance of the long history of the building industry and its sense of tradition. But these are exceptions. The usual attitude to attitudes has been a shallow one with no reference to cultural setting or historical roots. It is only recently that industrial psychology has taken cognisance of 'the culture of the factory'; it has still not adequately taken account of the wider cultural influences on work.

Yet, as W. I. Thomas (1951) for one saw, it is not until we get outside our own cultural systems that we begin to realise the assumptions, evaluations and attitudes of our own milieu. Hence the importance of cross-cultural studies. It can be taken as a general rule that, as Firth (1929) expressed it in his book *The Primitive Economics of the New Zealand Maori*, "the social setting of all economic life moulds to an inestimable degree the character of personal activity". There is indeed a considerable body of material already available to the industrial psychologist on the attitudes and behaviour of workers in other cultures. It is perhaps symptomatic of the industrial psychologist's lack of interest in this material that not one of the books or reports in this field has ever been reviewed in *Occupational Psychology*. This is not, of course, a stricture on the illustrious editors of this journal, but an indication of the prevailing frames of reference of industrial psychologists generally. I have never, for example, seen any references made by any industrial psychologist to the Colonial Office *African Labour Efficiency Survey*, edited by Northcott (1949). Yet there is much that is illuminating in this report, particularly in its picture of the native worker as "a man who has not acquired the habit of disciplined work, to whom physical effort is a thing to be avoided, and responsibility a virtue not yet inscribed on his role of moral qualities".

In a sense facts like this are well known, and have been known for long. Marshall (8th edition, 1920) in his *Principles of Economics* noted that savages (as they were still then termed), though ready at times for the most arduous exertions, "were incapable of keeping themselves long to steady exertion". Baffled Europeans confronted with the problem of obtaining work from natives have had recourse to slavery, forced labour, poll taxes and other impositions, or have abandoned the attempt and introduced Hindus, Chinese, or other peoples whose attitude to work was different. The facts have been documented with a wealth of detail in works like Greaves' *Modern Production among Backward Peoples* (1935) and van der Horst's *Native Labour in South Africa* (1942). More recently Margaret Mead's (1953) UNESCO report *Cultural Patterns and Technical Change* is a good illustration of the way in which cross-cultural material can be used to suggest general principles. The report contains many observations on attitudes to work. A particularly interesting contrast is that between the work attitudes of the Spanish Americans of New Mexico and the predominant Anglo-American attitudes. For the Spanish Americans "there is no moral corruption in being idle or in staying away from one's job". "A worker may stay away from wage work, but may spend the day repairing a neighbour's door or helping build a hen house for nothing." "The young person who seeks an Anglo adjustment not only needs new skills, he must also acquire a wholly different set of attitudes of aspiration and persistence." Facts like this, as I have said, are well known. It is the systematic implications of the facts that in general seem to have been missed. Here is a rich mine of material for forging a theory of work that will embrace the deeper attitudes to work, and the place of work in the 'belief-value matrix'. We want this material not primarily in order to understand natives, but in order to understand ourselves, in order to create a general theory of work and attitudes to work that will illuminate much that is obscure in our own situation and help to reveal the way that attitudes to work are formed, persist and change.

Certain broad conclusions seem clearly to emerge from cross-cultural studies of this kind and to confirm the qualitative studies previously mentioned. Firstly, attitudes to work are cultural acquisitions bound up with many features of social organization, economics, and ideology, and linked to personality structure; secondly, the roots of these attitudes go deep into the historical past; thirdly, though extremely persistent, such attitudes are not unchangeable.

The connection between attitude to work and social organization was noted two and a half thousand years ago by the father of anthropology, Herodotus (*c.* 427), who observed that different attitudes to work were a question not of race, but of government and economy. Recent theories have stressed the economic factor. Huntington (1928), to take a specific example, comments on the influence of rice growing. "Wherever rice is raised not only do standards of living rise, and the qualities of thrift and industry increase, but a selection occurs which gradually weeds out those who will not work, and who will not submit to authority." The ideological factors accompanying the increased will to work in Western Europe at the beginning of the industrial revolution have been described by Sombart, Weber, Tawney, Tilgher (1931) and others, and are now so familiar that they need not be described again. Finally, there is a good deal of clinical and psychoanalytic evidence suggesting that personality structure and attitude to work are closely related, that work is one of several ways of securing reassurance against neurotic anxiety, a way agreeable to some, to others profoundly disagreeable. Attitudes to work, then, cannot be understood except against the whole background of a culture and the predominant personality structure that goes with it.

Nor can they be understood without history. Psychology made a notable step forward when psychologists recognised that social context was an integral factor in the explanation of behaviour. The role of history is just as important, but much less generally recognised even by social psychologists. The 'control from around', of which Mace (1948) spoke, in his chairman's address to the Social Psychology Section of the British Psychological Society, is only part of the story: there is also 'control from behind', from 'the past in the worker's mind', as Zweig put it. History is an essential collaborator and partner among the social sciences. Without history we cannot hope to understand those 'time-scales of attitude change' of which Stansfield (1951) has spoken, still less the very nature and meaning of the attitudes with which we find ourselves equipped or confronted. In extreme cases this is obvious. Greaves (1935) has noted that "the legacy of a slave regime seems to be a complete apathy to self-improvement". "The peasant during serfdom", writes Jan Slomka (1941) in his memoirs of a Polish village mayor, 1842-1927, "got used to working on the land as an imposition. He only wanted time to pass . . . so he pottered along from day to day. This went on for 20 years after serfdom ended, and only then did improvements begin". The ILO *Report on Forced Labour* (1929) contains much similar evidence on the after-effects of compulsion. Clearly in instances of this kind present attitudes cannot be explained without a knowledge of the past. What is true of obvious cases is equally true of the more subtle and complex situations which occur in western industrial societies. It is true, as Graham Hutton (1953) saw, of ourselves. "The average European today is unaware of the persistence into his own day of sociological, psychological, and cultural 'hangovers' from, say, the time when the Middle Ages created new classes, and fixed men in groupings of skills, 'orders', and 'estates' . . . Yet those influences affect productivity through human relations and attitudes today." So history is preserved not only in the memories and habits of individuals, but in the traditions, customs and institutions of social groups. Neither industrial psychologist nor industrial sociologist should ignore this historical dimension.

Attitudes, however, though often persistent and stretching back into history, are not unchanging or unchangeable. Strong attitudes may slowly and imperceptibly erode and decay. New attitudes may emerge in response to the challenges of man or nature. The Carnegie report (Wilcocks, 1932) on the poor whites of South Africa, a document of great psychological interest, vividly illustrates how in unfavourable circumstances a European group can lose most of its characteristic attitudes to work. Many of the customary incentives cease to operate, and the process of re-education is prolonged and arduous. Whether in Great Britain attitudes to work have slowly eroded is difficult to determine scientifically, though anecdotal evidence is not hard to come by. Wiles (1951), an Oxford economist, who has attempted to compare the will to work in various western countries, quotes reports suggesting such a decline. Emerson (1856), for instance, who visited England in 1847, wrote: "An Englishman, while he eats and drinks no more, or not much more than another man, labours three times as many hours in the course of a year as any other European. . . . He works fast. Everything in England is at a quick pace". Wiles attempts to check the almost universal belief that English workers now work less hard than other western Europeans by obtaining data from international firms with branches in various countries. Although there are difficulties in interpreting this evidence, it all points in the same direction, to suggest that attitudes to work have eroded more in this country than elsewhere. This process in all probability has been going on some time, for Arthur Shadwell (1909), in his intensely interesting study of industrial efficiency in England, Germany and America in the first decade of the century, made many of the points which recent productivity reports have been making again nearly half a century later. An understanding of the dynamics of attitude erosion and attitude change is clearly crucial before effective intervention by psychologist, sociologist or administrator, and in spite of the anthropological literature listed by Mead (1953), and the psychological experiments discussed in the more recent textbooks of social psychology, our knowledge in this field is still exiguous.

The study of attitudes, in the wider sense in which I have been discussing them, certainly goes beyond industrial psychology as conventionally conceived, and, it would generally be agreed, is a matter in which the collaboration of various disciplines is essential. But if Graham Hutton is right in his opinion that 'the hangover of traditional long-standing British attitudes to work' is the greatest single drag on industrial efficiency in this country, it matters little whether the problem fits within neat boundaries or not. It becomes a problem that demands investigation. What then is to be done about it?

We cannot do much until we know more. We must clarify our minds as to the nature of the problems, and acquire more factual knowledge. The qualitative impressions of productivity reports and the like must be backed up with more precise information. But first, if our efforts are not to be wasted, we must clarify our minds. A general attitude to work is something different from the specific attitudes which are commonly investigated in attitude surveys. The problem in its simplest terms is the place of work in a more comprehensive 'belief-value' system. Judging from the literature this problem has received no systematic treatment; it has suffered from the general neglect of values by psychology.

Attitude to work in this sense must not be confused either with morale or with incentives. Morale has been defined (Smith & Weston, 1951) as "an attitude of satisfaction with, desire to continue in, and willingness to strive for the goals of a particular group or organization". The goals of the group, however, need not embrace a high evaluation of work. Nor is attitude to work merely a function of incentives. As soon as we pass beyond the cruder biological incentives, incentives become dependent on, and subsidiary to, values and the attitudes that derive from values, not *vice versa*. Cross-cultural studies make this last point clear beyond doubt.

Into the problem of attitude to work thus defined three main lines of research suggest themselves, the comparative, the genetic, and the psychometric. Probably comparative studies between cultures and between institutions and groups within cultures are the best way of discovering the dynamic influences upon which attitudes depend. In these studies the historical dimension should be included. In the genetic field singularly little has been done to explore the genesis of attitudes to work in the individual. We know much less about the character structure of the good workman, technician or professional man than the character structure of the young delinquent. The underworld has had more than its share of psychological attention. Attitudes to work are acquired in the process of growing up. What in fact are the formative influences upon which such attitudes primarily depend? What part do family influences play? To what extent in our culture are attitudes to work acquired at school? What is the effect of different types of education, or vocational placement, of the way a young person is introduced to work, of methods of industrial training, of blind alley jobs? Again, what permanent influence do breaks in continuity of work have—military service, for instance, or periods of unemployment? These and numerous other questions can be asked but hardly answered. Yet we could unquestionably learn as much by careful observation about the development of attitudes to work as we have about cognitive development.

It is probably right at this stage that our studies should be mainly qualitative and aimed at getting the size and feel of the problems. But before long better ways of assessing attitudes, particularly these deeper attitudes which are more often implicit than explicit, will be needed. As Tolman has pointed out, it is doubtful if the 'belief-value matrix' can be adequately penetrated by direct verbal methods. Possibly the way people spend their time and their money, the two main expendable commodities, may prove to be better measures of their scale of values.

No doubt by comparative, genetic and psychometric studies we could gradually build up a sizeable volume of reliable data about attitudes to work. To what end might this knowledge be used? The kind of technical society in which we have come to live and in which perforce we must continue to live, assumes that the bulk of the population possesses a sufficiently responsible attitude to work to carry out their jobs with regularity, with competence, and with a certain devotion to duty; that some men at least will be sufficiently interested to undergo prolonged and often exacting technical or professional training; that an increasing number will apply to the building, maintenance and control of the expensive and often dangerous apparatus of civilization meticulous care and attention; that numerous others will devote their services to promoting the health, well-being, and enjoyment of the community. To an extent for which there is probably little justification, we tend to assume that such a responsible attitude to work is for most men in the nature of things, and that a little discipline and a few modest incentives are enough to make all but a few ne'er-do-wells toe the line. We have insufficiently realised the unusualness, and perhaps the precariousness, of the kind of attitudes to work upon which our civilization rests. That we shall maintain what our ancestors have achieved is by no means certain ; that we shall improve upon it and be able to win the advances in social welfare which we desire may be impossible unless we deliberately contrive it. Work, not in the sense of physical effort, but work as a mastery of technique, as control, attention and service is the lynch-pin of modern society. And work in this sense depends even more than does physical labour on the attitude of those who perform it. Attitude to work, then, is fundamental to the very continuance, still more to the progress, of society. There is no more important question for the industrial psychologist to turn his attention to than the way attitudes to work arise, grow and are transmitted.

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Satisfaction and Satisfactoriness: Complementary Aspects of Occupational Adjustment

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Dr Heron is a member of the Medical Research Council's Unit for Research in Occupational Adaptation. This paper is an expansion of one presented before the Annual Meeting of the Canadian Psychological Association, held in Montreal, 4th-5th June, 1954.

INTRODUCTION

IN a previous paper (Heron, 1952) a report was made on the development of two criteria; one was of individual productivity, the other measured the extent to which an employee was a source of concern to his supervisors. Both these criteria were therefore of 'satisfactoriness', *i.e.,* of that aspect of occupational success which represents the viewpoint of the employer.

The objective of the later work here reported was threefold: first, to effect if possible some methodological improvement in the evaluation of satisfaction; second, to ascertain the way in which the previous measure of 'supervisory concern' is related to other measures of satisfactoriness; and, third, to provide a little further evidence concerning the relationship between the two complementary aspects (Rodger, 1937) of occupational success. The whole enterprise formed part of a long-term follow-up of new entrants as bus conductors (without previous experience), concerning whom a large quantity of psychological data had been obtained in their first fortnight of employment.

THE SAMPLE

Of the 210 men originally studied, 147 completed 26 weeks of service at their respective garages. Of these, 3 resigned or were discharged almost immediately afterwards. The remaining 144 men were interviewed within a fortnight of the date on which they reached the 26-week 'target'. It will be evident that the range of any measures of satisfaction or satisfactoriness is restricted by the loss of the non-stayers, and that the results to be presented are based upon a group of relatively stable and successful men so far as this particular occupation is concerned. The age range was 19–45.

SATISFACTION

Content of Interview

Each man was seen individually for thirty minutes in a private room near the central training school, at a time convenient to himself. The interview was expected by the man, insofar as at a preliminary ten-minute talk four months before, the writer had mentioned his desire to see everybody after 26 weeks of service in order to get their views about the job. The interview session was structured except for the last section, and adhered to a pattern which is here set out in full to make clear the context in which the assessment of job satisfaction was attempted:

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1. Explanation of the purposes behind the whole research of which this formed the final stage.
2. Appeal for complete frankness about the demands of the job, with reminder of confidential basis.
3. Clarification of man's attitude towards becoming a driver.
4. Rank-ordering of relative importance to him of 12 aspects of "any job—ignoring this job altogether".
5. Procedure to assess job satisfaction.
6. Rank-ordering of 10 aspects of the bus-conductor job from most liked to most disliked.
7. Standard questions leading to
8. Open-ended section concerned with stresses and causes of grievance.

Assessment of Job Satisfaction

Items were gathered from the unpublished work of Kristy (1952) and of Carlsson (1951) of the Survey Research Center to form a job satisfaction inventory. A few were altered sufficiently to make them more relevant to the bus conductor job, and one, relating to hours and shifts, was specially prepared in view of the general opinion that this aspect was one of the least-liked about the job. The inventory contained 15 items, which are listed in Appendix 1 with annotations to indicate source. Two administrative procedures were used with each man. The first, to be referred to as Form A, involved the presentation to the subject of each item in straight question form on a card 12 inches long by 5 inches wide. Below the question was a strip of plain paper, octavo length (8 inches), through which was visible a black horizontal line. One end of the line was always "FULL MARKS" and the other end styled appropriately to the question, *e.g.*, "DON'T LIKE", or "VERY POOR". Each card was reversible, so that a single sheet of octavo paper, folded lengthwise, and held by paper-clips, served two questions. This simplified scoring and preparation for re-use.

A demonstration item (unrelated to work) was worked through with the subject, in order to ensure that he understood clearly what to do. He was told: "One end of the line that you can see through the paper represents perfection—couldn't possibly be better—so it's called FULL MARKS. The other end is the opposite extreme—couldn't possibly be worse. Where you make your pencil mark on the paper will be a way of saying how you feel about the matter raised by the question. If you think there is *no* room for improvement, then of course you'll put your mark right up at the FULL MARKS end. If you think there is *some* room for improvement, then your mark will have to be back a bit from the end. The idea would be the same at the other end, of course. You can use this way of saying how you feel so as to grade your answer as finely as you want. Is that clear? (*Pause.*) (*Answer questions.*) Now use this one as an example and put your mark across the line at the point which indicates how you feel on this matter." His mark was then interpreted to him in words, and further explanation and practice used if necessary. Great emphasis was laid upon the desirability of making use of the whole line and of avoiding extreme judgments unless they were what he really felt about the particular question. No attempt was made to suggest normality of distribution.

On completing the 15 items by this method, of a general type described by Viteles as 'linear rating scales' (1932, p. 211), a start was made immediately with Form B, introduced by explaining that "we are now going to do the same thing in a different way, because what suits one man doesn't always suit another".

The second method, using the same items (in the same order) as questions or incomplete statements (Form B) followed by five descriptive phrases, is familiar from merit-rating procedures. Each item was on a separate card, and the subject was asked to "say which of the five descriptions *comes nearest* to expressing how you feel. Just say 'a' or 'b' or 'c' or 'd' or 'e' and I'll make a note of it here". A warning was added: "By the way, the five descriptions are NEVER in any order of merit or goodness; I've purposely mixed them up".

While recording the answers to each item using this descriptive method, the answer given to the corresponding item in Form A was inspected. Any items involving contradictions were put to one side, and at the end of Form B administration the writer said, "Now let's have a look at some of the questions where perhaps you didn't find it equally easy to say how you felt by both methods". This comparison led to discussion of contradictions, clarification of meanings, and to the subject being asked to "alter either or both of your answers so that you feel they both represent your opinion fairly".

Statistical Treatment

The linear method was scored by the simple expedient of laying a ruler along the record paper and making a note of the distance in centimetres which the subject's pencil mark was from the 'unfavourable' end. The distribution of these Form A scores for each item was then split as close to the median as possible and tetrachoric correlation coefficients calculated between Form A and Form B, the latter responses being split in such a way as to conform as nearly as possible to the Form A split. Wherever feasible, two Form B splits were tried out and the average coefficient taken. These coefficients provide a rough estimate of internal consistency for each of the 15 items in the inventory, and are listed in Table 1; it should be noted that the consistency referred to is of the item *after* discussion and alteration.

For the purpose of examining the intercorrelations between the 15 items, the linear (Form A) scores were used, divided for each item into 'Satisfied', 'Middle', and 'Dissatisfied' groups by splits at the 30th and 70th percentiles. Product-moment correlations were calculated* and the resulting matrix factor-analysed by the centroid method. Three factors were extracted which together accounted for 37.2% of the variance. Examination of bi-variate

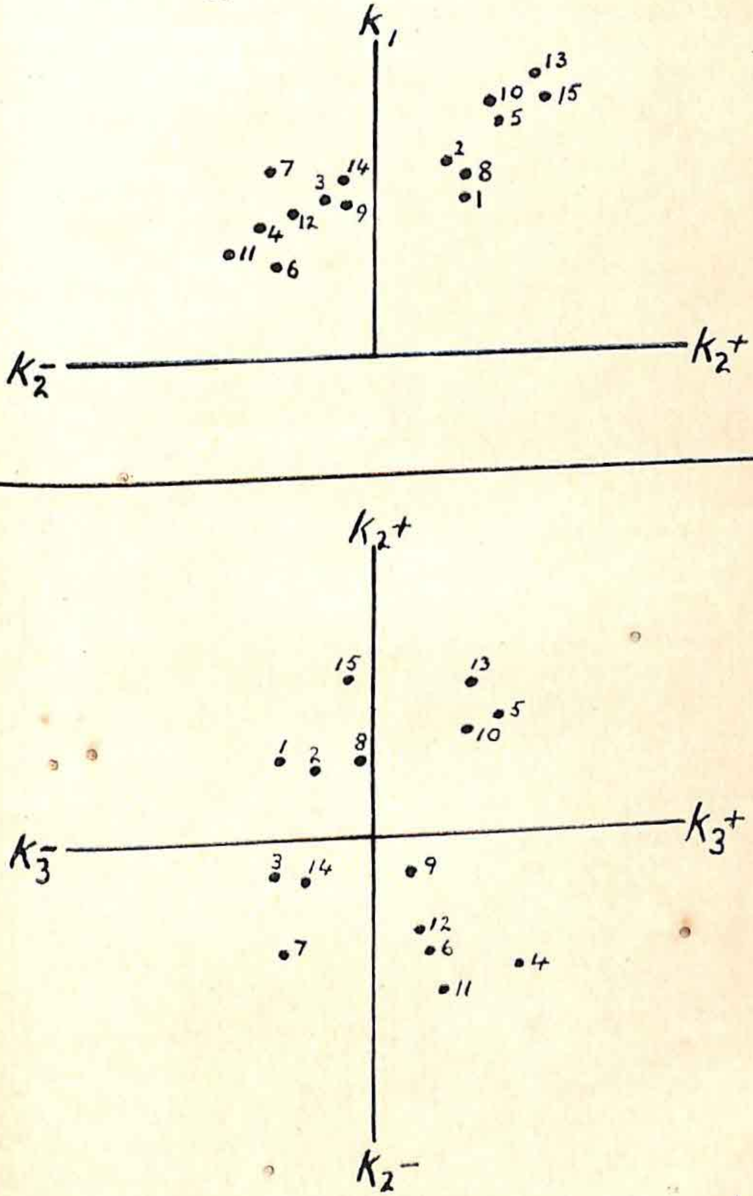

FIG. 1: UNROTATED FACTOR LOADINGS (CENTROID ANALYSIS), SHOWING CLUSTERS SUGGESTING GROUP FACTORS.

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* The coefficients obtained are of course shrunk by coarse grouping, but uniformly so. Provided no importance is attached to their absolute size, this procedure is in order for the present purpose.

plots of the loadings on each pair of factors before rotation (see Fig. 1) suggested the possibility of two main group factors, each consisting of two sub-groups. This suggestion was strengthened after rotation, and a group-factor analysis was therefore carried out, following Burt (1950); the impression was, with some imperfections, confirmed. Table 1 lists the 15 items in their four groups, showing the loadings of each item on the general factor obtained in the first stage of the group-factor analysis; the group-factor loading; and the estimate of internal consistency.

TABLE I: STRUCTURE OF THE SATISFACTION CRITERION

A—POSITIVE ELEMENTS	ROTATED LOADING ON GENERAL FACTOR	LOADING ON G.F.A. GENERAL FACTOR	LOADING ON RELEVANT GROUP FACTOR	CONSISTENCY ESTIMATE
A–1. *Intrinsic Liking for the Work Itself*				
*5. How do you like the *kind of work* that you do?	67	59	46	65
*10. How *interesting* is this job?	69	64	41	70
*13. How do you *like* your job?	81	74	39	70
A–2. *Satisfaction with Present Employment*				
*1. How do you feel you have *got on* since coming here?	49	37	49	55
*2. How does .... compare as a *place to work?*	56	49	42	65
8. As an *employer*......... is.........	52	47	11	55
15. How *satisfied* are you with your job?	79	66	17	75
B—NEGATIVE ELEMENTS				
B–1. *Aspirations and Adjustments*				
*3. How much does your job give you a chance to *do the things you are best at?*	30	40	37	90
*7. The *hours* on this job	31	48	46	50
14. How do you feel about your prospects of *advancement* here?	36	47	22	80
B–2. *Acceptance of Pressures (Physical, Financial, Disciplinary).*				
*4. How *tired* are you at the end of the day?	09	23	55	65
*6. My *mates* think this job is	06	19	31	75
9. My *average earnings are*	29	38	10	70
*11. *During peak hours* a guard has to work	00	17	50	80
12. How well is the .... *run?*	17	31	32	85

It seems obvious that the general factor represents "overall extent of satisfaction". The two main components may perhaps be described as the 'positive' and 'negative' aspects of satisfaction. The positive section seems to fall fairly clearly into one group of items (5, 10 and 13) concerned with what has been called "an intrinsic liking for the actual nature of the work itself"; and a second, contrasting, group of items (1, 2 and 8) representing a more general satisfaction with the job in a wider context. The negative section falls into one group (Nos. 3, 7 and 14), which may (with less confidence) be styled "aspirations and adjustments", and another (Nos. 4, 6, 9, 11 and 12) which seems to involve the acceptance of pressures—physical, financial and disciplinary.

Pooling squares (Thomson, 1948) were used to estimate the contribution made by each item to a unit-weight multiple correlation with the appropriate group factor, and ten items were selected by this means to form a composite Job Satisfaction Score which would adequately represent all the four components revealed by the factor analyses. These ten items are marked with an asterisk in Table 1. The four group factors are represented to the extent of unit weight R's of .50, .55, .50 and .65 respectively; the general factor to the extent of an R of .80. The average internal consistency of the ten items is .70; this means, of course, that the consistency of the 10-item composite score is considerably higher. All the subjects were, of course, equated for experience at this kind of work; there is a slight but significant linear correlation with age (+.178, $P<.01$). There is no suggestion in this sample of the cyclical relationship with age mentioned by Hoppock and Super (1950, p. 130).

VALUE TO THE EMPLOYER ("SATISFACTORINESS")

Variables Obtainable from Records

These were five in number, all in totals for the first 26 weeks of garage service:

(a) Gross earnings;
(b) 'Shorts' on cash handed in for tickets sold;
(c) Number of periods of absence, irrespective of cause or duration;
(d) Divisional disciplinary actions;
(e) Number of times late for duty.

Some comment is necessary in respect of this group as a whole and also in reference to individual items. The 144 men were drawn from four garages, and it was therefore essential, for each variable, to compute separate means and variances, to test for significant differences between garages, and to apply simple systems of weighting where necessary. This was the case with items (d) and (e).

'Gross earnings' can be regarded as a valid measure of 'value to the employer' in this instance, insofar as it is a direct measure of the extent to which individuals varied in their availability for overtime duty in a system which is dependent for its smooth operation upon a large measure of such 'additional' work. 'Divisional Disciplinary Actions' are in respect of reports made by the uniformed traffic inspectors, and arise from 'offences' such as failure to collect fares, or to alter route indicators at the termini

Normalised 5-Point Rating—" Source of Concern to Supervisors"

This was obtained within each garage by the method described in a previous paper (Heron, 1952), with a slight modification made desirable by the circumstances. After each of the three supervisors within each garage concerned had completed his set of normalised ratings, the writer arranged a meeting at which the supervisors were asked to discuss first all the men who had received a grade 5 (poor) from any of them, and to decide which were the men whom they could agree to be the worst. (The maximum sought was of course the number equivalent to the required proportion (11%) of grade 5's in the total number of men at that garage involved in the rating procedure.) When the supervisors had done this, all the remaining 5's automatically became grade 4's, and the procedure was then applied to grade 4, grade 1 and grade 2, in that order. This method avoided the difficulty of combining dissimilar gradings without adequate statistical evaluation, and also satisfied the supervisors that the method was designed to be fair to the men and to themselves as judges.

It is probably reasonable to assume that the re-test reliability of this normalised 5-point rating is of the same order as that obtained in the previous study, viz., about .8.

Statistical Treatment

All but one of the 5 variables obtained from records were converted to normalised percentile scores: Earnings and Shorts in 5 groups, Lates and Disciplinary Actions in 3 groups. It should be noted that it was not possible to normalise Absences, in view of the acute J– distribution usual with such data. A 3-group score was used, which divided the 144 men into 57 with no periods of absence, 37 with 1 period only, and 50 with 2 or more.

These 5 variables and the rating were then intercorrelated and the resulting matrix of product-moment coefficients factor-analysed by the centroid method. Two factors were extracted, accounting respectively for 32.4% and 8.3% of the variance. The intercorrelation matrix and the factor loadings and communalities appear in Table 2.

TABLE 2: INTERCORRELATION MATRIX, FACTOR LOADINGS AND COMMUNALITIES, "VALUE TO THE EMPLOYER".

	SCORING DIRECTION	CORRELATION MATRIX					FACTOR LOADINGS		
		2	3	4	5	6	I	II	h2
1. Superv. Rating	Poor	·304	·505	·382	·127	·483	·70	·03	·493
2. Gross Earnings	Low	—	·095	·414	·057	·241	·44	–·42	·372
3. Cash Shorts ...	High		—	·272	·230	·447	·61	·32	·473
4. Periods of Absence ...	Many			—	·018	·369	·56	–·33	·426
5. Divl. Disc. Actions ...	Many				—	·274	·28	·27	·148
6. Lates ...	Many					—	·70	·14	·513

Variance accounted for: 40·7%.

That Divisional Disciplinary Actions is less closely related to the other five variables is explicable mainly by the fact that administratively there had been little or no liaison between the supervisory staff in the garage and on the road so far as the conduct of individual men is concerned. For theoretical purposes this is fortunate, as it enables us to take note of the correlations between this administratively independent variable, shortages (.230), and lateness (.274), which though small do suggest a significant pattern of individual differences. To some extent there may be a tendency for these three criteria to reflect a form of behaviour which might be called 'irresponsibility' or 'lack of attention to details'—the opposite of 'meticulous' or 'obsessional'. Some support for this conjecture may be found in the fact that among the men regarded by a psychiatrist colleague as 'below average in obsessionality or meticulousness', a disproportionately large number were found to be 'high' in shortages, lates and disciplinary actions. (Of these associations, the two former were statistically significant, and the last, while obtaining a P of .3, was in the same direction.)

The general factor, Value to the Employer, has a multiple correlation of .86 with variables 1, 2, 3 and 6, using unit weights, after omitting variable 5 because of its independence and variable 4 because of its statistical shortcoming referred to earlier. The composite score was found to be correlated significantly and linearly with age (+.522). The four components of the composite score exhibit a similar association with age, as follows: Supervisors' Rating, +.403; Earnings (Availability), +.418; Shortages, +.282; Lates, +.445. In summary, younger men tend to be more often late, to be less available for overtime duties, and to be more 'out' in their cash. However, although the Supervisors' Ratings are to some extent influenced by the age of the men, largely no doubt as a result of the tendencies just summarised, they are still based in fair degree upon impressions derived from actual behaviour, as can be found by holding age constant when examining the correlations between Supervisors' Ratings and the other criteria: with Earnings (Availability), +.163; with Shortages, +.445; with Lates, +.370. This may justifiably be regarded as providing evidence of the validity of the Supervisors' Rating, while making it clear that for the purposes of raising the reliability (and probably the validity) of the Satisfactoriness criterion it is desirable to add the objective records to the rating, thus in effect giving additional weight to the former by reason of the overlap. When using the composite criterion score in connection with independent variables, it is of course essential to hold age constant by partial correlation.

The data and remarks above should be compared with the finding in an earlier study (of factory workers) that although the Supervisory Rating was correlated +.425 with age, this shrank to +.015 when the effects of length of service were held constant. No such problem arises in the present study, as all the men had equal service. This comparison emphasises the imperative need for obtaining and using all possible collateral data when establishing and evaluating criteria of occupational success.

Relation between Job Satisfaction and Value to the Employer

These two criteria of the complementary aspects of occupational success of new entrants as bus conductors were found to be correlated +.353. The regression is linear and when age is held constant by partial correlation, the correlation between the criteria becomes +.308. Further reference to this finding appears in the Discussion.

DISCUSSION

Method of Eliciting Satisfaction Responses

The evaluation of job satisfaction usually seems to be attempted by one of two means: the questionnaire or the interview, *cf.* Ghiselli and Brown (1948); Lawshe (1953). There seems to be no good reason why the two methods should not be combined in order to maximise the advantages and minimise the drawbacks of them both, though no suggestion to this effect is made by Blum (1949) or by Hoppock and Super (1950) in their respective reviews of this topic. This is not likely to be achieved simply by bringing a man to an interview room in order to let him fill out a questionnaire, but rather by re-designing the questionnaire procedure in such a way as to make it an integral part of the interview, which has, for example, been done by Marriott (1953) and his collaborators. Doing this by treating each item separately is in any event likely to reduce halo effect by separating in time items similar in content, and by focussing the subject's attention on each item in visual isolation from all others. This, however, is still not enough of a marriage between the two methods; and the technique reported in this paper—of ensuring discussion about item meaning through the use of two ways of item-presentation and scoring, within the context of an interview situation—is suggested as the next step.

One consequence of using this double-presentation approach was to convince the writer afresh of the dangers and difficulties implicit in the descriptive-phrase type of multiple response when used on its own—and especially when in the form of a printed questionnaire uncontrolled by interview. The majority of the discussion on contradictory responses arose directly from individual differences in perception of the values implicit in the five choices of response. There is no doubt that the wording of many of them could now be greatly improved; an attempt could be made to get them into scale form by recognised methods: but the problem would remain. This is not to say that the graphical method as used is perfect: far from it; but the experience with these 144 men was clearly that, once explained and worked through by example, the graphical method gave rise to less difficulty. However, it seemed to need the check provided by the verbal-description method, especially for those men who tended to hug the extreme position and waste the flexibility afforded by the length of the line. The writer feels justified in hoping that other workers will try out the double-presentation technique and report their experience. In this way, something may be done towards meeting the practical challenge thrown out by Rodger (1952): "The main task of the psychologist in this field . . . is not to disparage the interview but to improve it".

A word may here be in order concerning the choice of statistical methods for the treatment of these data. The first principle employed was that of avoiding a spurious appearance of precision ; the second, of maximising independence from the judgments of the interviewer. The choice of tetrachoric correlation coefficients for estimating the degree of association between the responses obtained to alternative methods of presentation adheres to the first principle; the use of factor analysis, by avoiding impressionistic grouping of the satisfaction and satisfactoriness variables, is loyal to the second principle. It should be noted in passing that the sub-scores of the satisfaction criterion, based on the group-factor analysis, were employed in the follow-up study, as separate variables additional to the total score; and that 'satisfaction with earnings' was also used as an independent single-item criterion.

The Analysis of Occupational Success

It is not proposed to review here the literature in this field, especially as valuable summaries exist (Blum, 1949; Ghiselli and Brown, 1948; Hoppock and Super, 1950; Viteles, 1932) ; attention should however be drawn to the useful service rendered regularly for some years by Hoppock, with various collaborators, in summarising job satisfaction researches. Verbal discussion of the whole problem reached a high level in the series of articles by Davies (1950), Stott (1950) and Reeves (1950), but it is probably safe to assume that none of these authors would feel they had provided an adequate, factually-based answer to the question, "What is Occupational Success?"

A 'dimensional' analysis seemed to be the next step. To be useful, it had to cover both the 'satisfaction' and the 'satisfactoriness' aspects of success simultaneously. Beginnings were made independently and roughly simultaneously by Kristy (1952) in a doctoral research under the direction of Rodger; by Carlsson (1951) and others in the Human Relations Project of the Survey Research Center; and by the writer. Through the courtesy of Rodger and Kristy and of the Director of the Survey Research Center, the writer was enabled for the present study to use items drawn from barely completed and still unpublished researches in the construction of his job-satisfaction inventory.

The situation in the bus conductor project was such as to preclude the use of a long and detailed satisfaction inventory, such as that employed by the Survey Research Center. Accordingly, the items were chosen as representative of the main areas of satisfaction reported by Kristy and by Carlsson, with the exception of supervision. This was omitted because there is a very real sense in which it is true to say that 'supervision' as ordinarily understood has no meaning for the bus conductor. He has no chargehand or foreman constantly nearby, as is the case in a factory, and it is very doubtful whether one can legitimately assume that he perceives the occasional inspector or the garage superintendent as supervisors in an analogous way.

Coverage of several possible areas of satisfaction was either not attempted or was inadequate; an example of the latter is 'earnings'. The 15 items used were expected to provide a rather broader-based evaluation than could be achieved simply by asking each man how satisfied he was with the job, and thus to enable some further examination of overall satisfaction.

Both Kristy and Carlsson used factor analysis to classify their satisfaction items, the former also including proficiency criteria in his combined matrices. Both workers obtained group factors, Kristy by Burt's method, Carlsson by "somewhat unorthodox orthogonal rotational methods" from a Thurstone multiple group analysis. Starting from grossly differing populations (261 post office counter clerks; 1,709 industrial workers, all grades, in a single factory), using dissimilar questionnaires and means of administration, and approaching the statistical analysis with contrasting theoretical considerations in mind, one would not expect anything resembling close agreement. One does not find it, but both workers demonstrated that job satisfaction was not uni-dimensional in their respective studies. Kristy also showed—he considers it himself to be his main finding—that satisfaction and satisfactoriness are almost wholly uncorrelated in his sample. In a later report (1951), based on Carlsson's work so far as job satisfaction is concerned, the Survey Research Center stated (p. 49) that more high than low producing employees say "(1) they prefer their present job rather than another job; (2) they like the actual kind of work they do". The writers of the report continue (p. 51): "It is difficult to interpret the positive relationship between productivity and overall job satisfaction. The relationship shows no causal direction. . . . Perhaps dislike of the job is what leads to low productivity. It is also possible that failure to meet productivity standards, with its concomitant effects of increased pressure, etc., leads to dislike of the job".

Some comparison is possible between the results obtained in the present study and those of Kristy and Carlsson. Of the 15 items used in the writer's job satisfaction inventory, seven came from Kristy's 18-item questionnaire and seven from the 117-item booklet used by the Survey Research Center at the Caterpillar Tractor Company. Of the former seven, two, and of the latter seven, three, were modified slightly to make them useable in the bus conductor study. Both sets of seven were found to be represented in all four group factors obtained in the present analysis.

Of the four items used in the Caterpillar report (1951) to form an index of satisfaction 'with the job' based on Carlsson's factor analysis, two were used in the present study (Nos. 3 and 5). It will be seen that on this occasion they did not come in the same group factor; as their intercorrelation was .18,* compared with .71 in the Caterpillar study, this is not surprising.

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* It will be remembered that this coefficient is shrunk by coarse grouping, but so is the Survey Research Center figure.

Item 12 in the writer's inventory ("How well is the Transport Department run?") obtained a loading of .75 in Carlsson's analysis on what he called the 'halo' factor; if this may reasonably be regarded as comparable to the writer's 'general' factor, the equivalent loading is .39 (unrotated) or .17 (rotated). In brief, there is little resemblance between the two studies so far as the degree of association between these few common items is concerned.

By contrast, two (Nos. 10 and 13) of the three items defining group factor A-1 in the present analysis are also items with high loadings in Kristy's comparable group factor and have commensurate loadings on the general factor in both studies. Other items in common also have similar loadings on the general factor, but the greatest difference is found in respect of the 'blanket' item, No. 15. In Kristy's analysis it has a relatively low loading on the rotated general factor (.54) compared with figures of .66 (unrotated) and .79 (rotated) in the present analysis, and the highest loading (.77) in his group factor 'D' (Satisfaction with Job Conditions) compared with a loading of .17 on group factor A-2 (Satisfaction with Present Employment). This strongly suggests that the major determinants of response to an overall or 'blanket' item are in fact located in areas differing from one job to another. While new bus conductors vary in their overall satisfaction mainly in terms of *positive* aspects of the job, post office counter clerks may well be more uniform in these aspects, and tend to vary more in consequence of their dissatisfaction with the *negative* aspects.

Finally, the present study does not in general repeat Kristy's finding that in an occupationally homogeneous sample there was no relationship between satisfaction and satisfactoriness; as previously mentioned, the two criteria were found to intercorrelate +.308 with age held constant. In connection with earnings treated in isolation, however, it was found that actual earnings (effectively a measure of voluntary overtime) only correlated +.160 (barely significant at P=.05 level) with answers to the question "How well do your average earnings (including overtime) supply a decent standard of living?"

The method of presentation employed by the Survey Research Center report (1951), while appropriate for an audience of industrial managers, does not provide enough detail for the present purpose. Without additional data concerning the interrelationships of satisfaction and productivity with other potentially relevant variables, it is impossible to evaluate the reported association between the two criteria of occupational success. As the writer has pointed out elsewhere (1954), we are evidently still a long way from understanding the composition of 'morale', and one stage on that journey would seem to be a clearer delineation of the relationship between productivity, satisfactoriness in other respects, and the various aspects of satisfaction. Blum (1949, pp. 76-77) was probably right when he insisted that job satisfaction is not morale, but only one of its components.

SUMMARY

1 This paper reports the development of criterion measures for satisfaction and satisfactoriness in respect of new omnibus conductors.

2 The method of assessing satisfaction is in some respects novel, and is put forward for consideration and further trial by other investigators.

3 Results obtained from the statistical evaluation of these criteria are compared with those obtained previously by the writer and by others.

4 Discussion is focussed on the continuing inadequacy of our knowledge about the structure of occupational success.

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APPENDIX 1

JOB SATISFACTION INVENTORY

Sources: K – Kristy ; C – Carlsson.

1	How do you feel you have *got on* since first coming here?	(C. 29 Modif.)
2	As a *place to work*, how does transport compare with other places in this area (or where you lived before)?	(C. 107)
3	How much does your job give you a chance to *do the things you are best at*?	(C. 114)
4	How fresh do you *usually* feel at the end of the day?	(K. 1)
5	Not counting all the other things that make your job good or bad, how do you like the *kind of work* that you do?	(C 108)
6	How do *your mates* think this job compares with most other jobs?	(C. 26 Modif.)
7	How convenient are the *hours* on this job?	(New Item)
8	How do you find the transport department as an *employer*?	(C. 106 Modif.)
9	How well do your average earnings supply a *decent standard of living*?	(K. 11 Modif.)
10	How *interesting* is this job?	(K. 4)
11	What is your opinion about the *speed* at which a guard has to work during *peak hours*?	(K. 3 Modif.)
12	How well is the transport department *run*?	(C. 110)
13	How do you *like* your job?	(K. 13)
14	How do you feel about your *prospects of advancement* in the transport department?	(K. 9 Modif.)
15	How *satisfied* are you with your job?	(K. 7)

Students' Progress in a Medical School

By A. E. MAXWELL

The work described here was carried out by Mr Maxwell when he was Research Fellow at the Institute of Education, University of Leeds, from 1951 to 1952. He is now Lecturer in Psychological Statistics at the Institute of Psychiatry, University of London.

THE primary aim of this study was to estimate the value of the first medical examination for predicting success in the medical school course. Consequent to this it was possible to compare the value of measures of prediction for the pre-clinical and clinical periods of the course. Measures of prediction for men and women students were calculated separately and their performances in the various examinations of the course compared.

THE SAMPLE

This was composed of five equal sub-samples chosen from students who entered upon their medical courses in the years 1941 to 1945 inclusive. For statistical reasons it was considered desirable that, as far as possible, all the students selected from any year-group should have taken the same examinations. To satisfy this desire, selection of students was restricted to those who completed the course within the recognised time prescribed for it. Students who had failed in any of the examinations between the first and the final, but who, by means of supplemental examinations or otherwise, had succeeded in keeping with their class, were deemed eligible for inclusion. The marks utilised for such students were those obtained by them in the normal examinations in the subject (Table 1), even though they had failed in their first attempt at one or other of these examinations.

Subject to the restrictions mentioned, selection was as follows: (a) the sub-samples were chosen equal in size to facilitate ready comparisons; (b) each sub-sample contained an equal number of men and women; (c) the number in each sub-sample was necessarily defined by the number of students of either sex eligible from the smallest year-group; (d) in accord with (a), the required number of students from the other year-groups was chosen by random selection.

The number of students chosen for the pre-clinical part of the course was 260, for the clinical part 190. The validity of combining statistical measures derived from different sub-samples was investigated by analysis of variance and homogeneity of variance techniques and no major objections were revealed.

THE MEDICAL COURSE

This study is confined to an analysis of examination marks allotted in the Medical School of the University of Leeds. For those unfamiliar with the procedure there, a few remarks about the medical course and the examinations to be passed will be helpful.

Admission to the Medical School for the years under consideration was, in the main, by selection from applicants who had satisfied the matriculation requirements laid down by the Northern Universities Joint Matriculation Board, and who had: (1) a knowledge of Mathematics at least equivalent to that of the 'pass' standard at a School Certificate examination; (2) a pass in Physics and Chemistry at 'principal' standard in a Higher School Certificate examination; (3) a similar qualification to that in (2) in an additional subject from an approved list which included Zoology and Botany.

Applicants who qualified under the above requirements were interviewed by a committee set up by the Medical School authorities. Particulars of the method of interviewing at this University, and of investigations being made to ease the task of dealing with a large number of applicants, are described elsewhere (Orton and Martin, 1948) and need not be reported here.

Once admitted to the Medical School a student follows a course which normally extends over five years and six months. At the end of this period, if he has passed the required examinations, he will have qualified as a doctor. The course may be divided into two periods—the pre-clinical and the clinical.

The examinations to be passed in each period can be seen in Table 1, where they are listed for one of the sub-samples used here.

TABLE 1: TIMETABLE OF EXAMINATIONS FOR SUB-SAMPLE 1.

DATE	EXAMINATION		SUBJECTS
March, 1942 ...	Pre-Clinical	First Medical Part I ...	Organic and Physical Chemistry
March, 1942 ...		,, ,, ,, II ...	Zoology, Botany
March, 1944 ...		Second Medical ...	Anatomy, Physiology
March, 1946 ...	Clinical	Final Medical Part I ...	Pathology, Pharmacology and Bacteriology
July, 1946 ...		,, ,, ,, II ...	Forensic Medicine, Public Health
March, 1947 ...		,, ,, ,, III ...	Medicine, Surgery, Obstetrics and Gynaecology, Therapeutics and Pharmacy

DIFFERENCES IN PERFORMANCE AT THE PRE-CLINICAL LEVEL

The scores of the students in each of the sub-samples for each of the five subjects of the pre-clinical part of the course were compared by analysis of variance techniques and by 't' tests, and the findings are reported below. As an example, details of the analysis in the case of Zoology are given in Tables

2a and 2b, and the results of the analyses for all the pre-clinical subjects are summarized in Table 2c.

TABLE 2a: AGGREGATE OF MARKS IN ZOOLOGY, FOR MEN AND WOMEN, 1942-1946

	1946	1945	1944	1943	1942	TOTAL
Women (n=130)	1,269	1,219	1,185	1,186	1,213	6,072
Men (n=130) ...	1,105	1,105	1,067	1,170	1,158	5,605
Total (n=260) ...	2,374	2,324	2,252	2,356	2,371	11,677

TABLE 2b: ANALYSIS OF VARIANCE OF DATA IN TABLE 2a

SOURCE OF VARIATION	d.f.	s.sq.	M.S.	V.R.	SIGNIFICANCE LEVEL
Between Sexes	1	838·8	838·8	7·96	0·01
Between Tests	4	197·5	49·4	—	
Sex-Test Interaction ...	4	259·2	64·8	—	
Between Classes	9	1,295·5			
Within Classes	246	25,928·5	105·4		
Total	255	27,224·0			

TABLE 2c: SUMMARY OF ANALYSES OF VARIANCE FOR ALL PRE-CLINICAL SUBJECTS

SUBJECT	LEVELS OF SIGNIFICANCE			
	BETWEEN SEXES	BETWEEN TESTS	SEX-TEST INTERACTION	SUPERIOR PERFORMANCE
Organic and Physical Chemistry	S.S.	S.	N.S.	Men
Zoology ...	S.S.	N.S.	N.S.	Women
Botany ...	N.S.	S.S.	N.S.	—
Anatomy ...	N.S.	N.S.	N.S.	—
Physiology ...	S.	N.S.	N.S.	Men

S.S.S.=highly significant
S.=significant at 5% level
S.S.=significant at 1% level
N.S.= not significant.

Chemistry: The men's performance is significantly better than that of the women. From year to year over the five years there is a significant difference between the scores of the men and women combined, but there is no significant interaction effect so we may conclude that the men are consistently superior. *Zoology:* The women's performance is significantly better than that of the men and the superiority is consistent. *Botany:* Neither sex shows a significant superior performance over the five years combined, but for the men and women separately significant differences appear from year to year. *Anatomy:* No significant differences appear. *Physiology:* The men's performance is consistently superior to that of the women.

Average figures for the means and standard deviations for the five sub-samples combined appear in Table 3. Each test was marked out of a maximum score of 100.

TABLE 3: MEANS AND S.DS. IN PRE-CLINICAL SUBJECTS

SUBJECT	130 MEN		130 WOMEN	
	MEAN	S.D.	MEAN	S.D.
Organic and Physical Chemistry ...	54·40	12·51	49·41	14·36
Zoology	43·12	10·50	46·71	9·86
Botany	57·20	13·05	58·75	12·05
Anatomy	53·05	10·97	50·87	11·58
Physiology	53·85	10·55	51·15	9·49

PREDICTION AT THE PRE-CLINICAL LEVEL

Here the three subjects of the first M.B. examination, namely, Organic and Physical Chemistry, Zoology, and Botany, are used as a battery to predict the subjects of the second M.B. examination, namely, Anatomy and Physiology. From the intercorrelations of these five subjects (Table 4) partial regression and multiple correlation coefficients were calculated (Table 5). The partial regression coefficients are the best weights to be applied to a person's scores (standardised) in Chemistry, Zoology and Botany to predict his most likely score in the criterion subject Anatomy or Physiology. They give, therefore, a measure of the relative values of the subjects of the predicting battery for predicting the criterion concerned. The multiple correlation coefficients give a measure of the value of the predicting battery (as a whole with best weights applied) for predicting the criterion.

TABLE 4: INTERCORRELATIONS OF ALL SUBJECTS, FOR MEN AND WOMEN

	CHEMISTRY	ZOOLOGY	BOTANY	ANATOMY	PHYSIOLOGY
MEN:					
Chemistry	1	0·4504	0·5503	0·6277	0·6517
Zoology		1	0·5138	0·4715	0·4226
Botany			1	0·5942	0·5508
Anatomy				1	0·7132
Physiology ...					1
WOMEN:					
Chemistry	1	0·6517	0·6601	0·6609	0·5663
Zoology		1	0·5934	0·5087	0·4985
Botany			1	0·5789	0·5728
Anatomy				1	0·7135
Physiology ...					1

TABLE 5: PARTIAL REGRESSION AND MULTIPLE CORRELATION COEFFICIENTS (Rm)

CRITERION	CHEMISTRY	ZOOLOGY	BOTANY	Rm
MEN:				
Anatomy ...	0·3989 S.S.S.	0·1350 N.S.	0·3053 S.S.	0·7039
Physiology ...	0·4808 S.S.S.	0·0802 N.S.	0·2450 S.S.	0·6944
WOMEN:				
Anatomy ...	0·4619 S.S.S.	0·0695 N.S.	0·2326 S.S.	0·6894
Physiology ...	0·2708 S.S.S.	0·1361 N.S.	0·3132 S.S.	0·6329

The partial regression coefficients were tested for significance and the results are entered above.

DISCUSSION

In a study of this kind, where a highly selected group is used and correction for selection is not possible, correlation coefficients tend to be low; in view of these facts we may consider the figures in Table 4, especially those for women, satisfactory. Anatomy and Physiology are relatively highly correlated, but the correlations between Zoology and the other subjects tend to be low.

The multiple correlation coefficients given in Table 5 are relatively high—the nature of the data being kept in mind—and show that the first M.B. examination is a good predictor of success in the second M.B. The partial regression coefficients show that the weight of prediction is carried by Chemistry and Botany, Zoology, owing to its lower correlations with the criteria, being outweighed.

DIFFERENCES IN PERFORMANCE AT THE CLINICAL LEVEL

In Table 6 below mean scores and standard deviations representative of the five sub-samples combined in the subjects of the clinical part of the course are shown.

TABLE 6: MEANS AND S.Ds. IN CLINICAL SUBJECTS

SUBJECT	95 MEN		95 WOMEN	
	MEAN	S.D.	MEAN	S.D.
Pathology and Bacteriology ...	56·71	7·85	55·57	9·06
Pharmacology	56·32	8·42	53·35	9·16
Forensic Medicine	59·12	8·90	57·39	8·31
Public Health	61·54	6·58	60·41	6·71
Medicine	52·07	5·67	51·90	5·73
Surgery	54·88	4·79	53·59	5·06
Obstetrics and Gynaecology ...	53·47	3·98	54·09	4·72

Analyses of variance similar to that shown in Table 2 were carried out on these subjects and the results are summarised in Table 7.

TABLE 7: SUMMARY OF ANALYSES OF VARIANCE

SUBJECT	LEVELS OF SIGNIFICANCE			SUPERIOR PERFORMANCE
	BETWEEN SEXES	BETWEEN TESTS	SEX–TEST INTERACTION	
Pathology and Bacteriology	N.S.	N.S.	N.S.	—
Pharmacology	S.	S.S.	N.S.	Men
Forensic Medicine ...	N.S.	S.S.	N.S.	—
Public Health...	N.S.	S.S.	N.S.	—
Medicine ...	N.S.	S.S.	N.S.	—
Surgery ...	S.	S.S.	N.S.	Men
Gynaecology ...	N.S.	N.S.	N.S.	—

On the average over the five years the men's performance in Pharmacology and in Surgery was superior to that of the women. The order of difficulty of the subjects for men and women students differed and is of interest. In the subjects of Parts I and II of the final examination the sequence for men, in ascending order of their performance in each, was found to be:

1 Pathology and Bacteriology } means not significantly different.
Pharmacology }
2 Forensic Medicine
3 Public Health

Here the differences between the mean-scores of 1, 2 and 3, taken in pairs, were shown by 't' tests to be significant, that between 1 and 3 reaching to 1% level, the others the 5% level.

For women students the order was:

1 Pharmacology
2 Pathology and Bacteriology } means not significantly different.
Forensic Medicine }
3 Public Health

The only significant difference here was a 5% difference, again using a 't' test, between the mean-scores in Pharmacology and Public Health.

In Part III of the final medical examination (clinical marks) the order of the subjects for men was:

1 Medicine
2 Obstetrics and Gynaecology
3 Surgery

The men obtained their highest scores in Surgery, and the differences between the mean-scores taken in pairs for these subjects were in each case significant, at the 5% level.

The order of these subjects for women students was:

1 Medicine
2 Surgery
3 Obstetrics and Gynaecology

They obtained their highest scores in the last subject. A significant difference (5%) was found between their mean-scores in Medicine and Surgery only.

PREDICTION AT THE CLINICAL LEVEL

At this level two composite criteria were used. An examination of means and standard deviations showed that students' scores in Pathology and Bacteriology, Pharmacology, Forensic Medicine and Public Health, on the one hand (Final M.B., I and II), and scores in Medicine, Surgery, Obstetrics and Gynaecology on the other (Final M.B. III), could be aggregated without any great loss of accuracy. This division of the clinical subjects into two groups was also justified on the time-basis since the subjects of the latter group were taken approximately one year later than those of the former group.

The required correlation coefficients between the battery and the criteria were now computed and appear in Table 8a. Next the partial regression and multiple correlation coefficients were calculated. They are given in Table 8b.

TABLE 8a: CORRELATION COEFFICIENTS BETWEEN THE BATTERY TESTS AND THE COMPOSITE CRITERIA

CRITERION	CHEMISTRY	ZOOLOGY	BOTANY
For 95 Men:			
Finals I and II ...	0·2281	0·2121	0·2801
Finals III	0·2457	0·1797	0·2532
For 95 Women:			
Finals I and II ...	0·4244	0·2998	0·4048
Finals III	0·4193	0·3057	0·3180

TABLE 8b: PARTIAL REGRESSION AND MULTIPLE CORRELATION (Rm) COEFFICIENTS

CRITERION	CHEMISTRY	ZOOLOGY	BOTANY	Rm
For Men:				
Finals I and II	0·1007 N.S.	0·0826 N.S.	0·1876 S.	0·3051
Finals III ...	0·1488 N.S.	0·0497 N.S.	0·1522 N.S.	0·2898
For Women:				
Finals I and II	0·2737 S.S.S.	0·0089 N.S.	0·2166 S.S.	0·4544
Finals III ...	0·3466 S.S.S.	0·0580 S.	0·0540 N.S.	0·4245

DISCUSSION

The low multiple correlation coefficients of Table 8b show that the battery in question has little predictive value for the clinical examinations of the course. This result was expected from the low values of the correlation coefficients in Table 8a. In the case of men the only partial regression coefficient which reaches significance, and this only at the 0.05 level, is that for Botany. For women the situation is better. Chemistry retains high relative value as a predicting agent, Botany is significant for the first parts of the final examination and Zoology appears significant for the first time.

GENERAL CONCLUSIONS

A full and sufficient discussion of the results found in this study, and an elucidation of some of the problems which they raise, would be difficult indeed. As a result the writer feels that this discussion and elucidation must be left to the authorities and examiners in the several examination subjects. An attempt is made here to deal only with the more obvious issues raised.

From the comparison of the performance of men and women students it appears that the balance is tilted slightly in favour of the men. Of the twelve examination subjects considered the men's performance in four of them is significantly superior to that of the women. This is especially important as our sample of women students is more highly selected than that of men students. It is also important in view of the general prejudice against admitting women students in any considerable number into our medical schools. It is well to remember, however, that the results offered in this study make no direct claim at predicting success as a doctor, and in that respect we must not allow a tendency towards prejudice to become established fact.

The superiority of the men's performance in Chemistry will probably be accepted by most readers without objection, but it is well to remember that this superiority is probably no more than a reflection of earlier training. Chemistry in boys' schools generally receives more attention than in girls' schools. A similar explanation possibly explains the superiority of the women's performance in Botany. Again, the superiority of the men students in Surgery may be accepted as natural, but a closer examination of the clinical test in this subject reveals that no actual surgical work, in the strict sense of the term, is involved.

When we come to consider the measures of prediction of success in the medical course it is possible to be somewhat more definite in our conclusions. Broadly speaking, the first-medical examination is a good predictor of success in the second medical examination, but a poor predictor of success in the final medical examination. This conclusion is true alike for men and women students. The weight of prediction in the first instance is carried by Chemistry and Botany. The complete collapse of Chemistry in the case of men students to predict the clinical examinations compared with its high significance for predicting these examinations in the case of the women students is difficult to explain, and the question must be left open.

Anatomy and Physiology, the subjects of the second medical examination, are factual, and to prepare for an examination in them a student requires a retentive memory. This is probably true also of Chemistry and Botany. The intercorrelation between these pairs of subjects all lie between 0.55 and 0.66 (Table 4). The correlations between Zoology on the one hand and Anatomy and Physiology on the other are smaller: all lie between 0.42 and 0.50. Not many students study Zoology as a school subject, and it has been suggested that in teaching it at the university level the aim is to present the subject to medical students in its broad cultural aspect. If this is so, it may help to explain the lower correlations between Zoology and the other subjects. Here the big question is raised as to the best attitude to adopt in the teaching of these basic subjects to students the majority of whom will become general medical practitioners rather than specialists in these subjects.

This question arises again when we consider the measures of prediction for the clinical part of the medical course. With the exception of Chemistry in the case of women students, the subjects of the first medical examination were found to have little value as predictors of success in the final examination. This finding is important in that it may suggest some lack of continuity between the pre-clinical and clinical parts of the medical course and further investigation is needed.

But relevant to the last remark another point deserves underlining. If we refer again to Table 3 we see that of all the standard deviations reported there and all tend to be too low—that for Chemistry for women students is the highest. A high standard deviation indicates a wide range of scores and suggests that the test concerned discriminated well between students. This fairly high standard deviation also affects directly the correlations between Chemistry and each of the other tests tending to increase them—the figures in Table 4 itself help to bear this out. Now with these considerations in mind, if we turn to Table 6 we find that the standard deviations reported there, especially those for the Final Medical Part III, are dangerously low. All subjects in this study are scored out of a total of 100 marks. A standard deviation of 4 and mean 53, as found for example for men for Obstetrics and Gynaecology (Table 6), means in effect that the examiners' marks lay overwhelmingly (95%) in the range 45–61. This means that the examinations differentiated very poorly indeed between the students. From a purely technical point of view it also means that one need not expect to find high correlations between Obstetrics and Gynaecology and the other subjects, especially since these also tend to have low standard deviations.

To conclude, it would be unreasonable to expect that from scores obtained by students in their pre-medical examination these students' performance in their final medical examinations five years later could be predicted with any great degree of accuracy. Nevertheless failure to make an accurate prediction might too readily be attributed to this time interval, or to the inadequacy of the predicting battery for prognostic purposes, when in actual fact the cause could be attributed to an examination system weak in discriminatory power. Perhaps if the discriminatory value of the examinations, especially of the final medical examinations, could be improved there would be no foundation for the suggestion made earlier regarding a possible lack of continuity between the pre-clinical and clinical parts of the course.

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Occupational Psychology: Index, 1938–1953

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In this Index, reference is made to all major articles published in *Occupational Psychology* since it acquired its present title. Volume numbers have been omitted, but issue numbers appear in brackets.

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The co-operation of social groups. *F. C. Bartlett*, 1938 (1), 30-42.
Science and social service. *Sir Richard Gregory*, 1938 (2), 134-138.
Intelligence and birth rate. *L. S. Penrose*, 1939 (2), 110-125.
On certain conflicts in occupational life. *G. Ichheiser*, 1940 (2), 107-111.
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Some problems of inspection. *Winifred Raphael*, 1942 (4), 157-163.
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The use and value of graphical methods of presenting quantitative data. *M. D. Vernon*, 1952 (1), 22-34.
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The use and value of graphical material with a written text. *M. D. Vernon*, 1952 (2), 96-100.
Resistance to change. *C. A. Mace*, 1953 (1), 23-29.
Social aspects of industrial change. *J. H. Smith*, 1953 (2), 80-88.
The Relay Assembly Test Room in retrospect. *Michael Argyle*, 1953 (2), 98-103.

Book Reviews

European Impressions of the American Worker. By ROBERT W. SMUTS. London: Geoffrey Cumberledge, Oxford University Press; and New York: Columbia University Press. 1953. Pp. ix + 62. Price 12*s*.

This is the first of a series of monographs entitled *Human Resources Studies* issued by the Graduate School of Business of Columbia University. In the Foreword the reasons for its production are given. "Because of lack of perspective, Americans have frequently failed to understand the sources of their country's strengths and weaknesses as well as those of other nations. Many of the difficulties which the nation has encountered during the post-war years in its efforts to assist the free world to rehabilitate and expand its economic structure are the results of the way Americans view their own history." Thus, although addressed primarily to readers in the U.S.A., the book has a very real interest to citizens of other countries as a determined attempt by Americans "to see themselves as others see them".

The book is in two parts. The first summarises the reactions to work and workers in America of a number of Europeans who visited the United States between 1885 and 1910. The second part is based on the reports of British Productivity Teams which paid their visits between 1948 and 1952.

This reviewer does not feel competent to comment on the first part of the book. For obvious reasons it has been necessary for the author to take only a minute sample of the travel literature of the period, and to test the representativeness of the sample quoted would require a minor research. The picture of America given by the different observers is, however, consistent. It is of a classless society, independent, hard-working, highly competitive, striving for innovation and the full exploitation of its natural resources, and of the paradox of bitter industrial relations existing together with whole-hearted support of free-enterprise capitalism.

The second part, which is based on 61 of the 66 Reports by British Teams sent to the U.S.A. under the auspices of the Anglo-American Productivity Council, can be evaluated more readily: the sampling of the reports at least can be checked.

The picture which emerges from the reports quoted is strikingly similar to that drawn by the visitors to the United States half a century earlier. It is one of drive, zest, intense but efficient work, widespread use of labour-saving methods, a highly competitive economy, an expansionist outlook, absence of support for socialistic theories, high and increasing productivity, and a high material standard of living. There is, however, one notable difference between the 1900 and the 1950 scenes: the Productivity Teams were impressed not by the bitterness of U.S. industrial relations, but by their harmony.

Two main points deserve careful consideration: first, is the picture a true one? second, what lessons can we draw from these studies?

Let us take the validity question first. This reviewer feels that Smuts has not adequately emphasised that the Teams visited a highly selected sample of American establishments. Scrutiny of the itineraries followed by the Teams shows that few of them penetrated farther west than Wisconsin or father south than Washington. Indeed, those Teams which travelled most widely were perceptibly more cautious in their generalisations about the human element. (The 'Training of Operatives' Team which went as far afield as Texas reports: "Citizens of States which are remote from each other often show differences of character that are almost nationalistic. . . . Each team must feel rather overawed by the immense size of the country". The 'Iron and Steel' Team, which travelled much farther than most, was inclined to be sceptical about the quality of industrial relations: "American life is characterised by less formality than is customary in Britain. Within the works friendly greetings and the use of Christian names are universal. These practices seem to create an air of comradeship between management and men and tend to encourage the feeling of belonging to the organisation. However, there did not appear to be the same fundamental mutual respect and trust as in the British industry ". The 'Gas' Team, which achieved something like a 'coast-to-coast hook-up', is notable for its blunt remark: "No evidence was produced that could satisfy the Team that the American gasworker in general was working harder than his British counterpart".) However, the issue of geographical sampling is something of a quibble, as the Teams did in fact spend most of their time in the most heavily populated and most highly industrialised part—the north-eastern quarter—of the United States.

Much more serious is the question of sampling on an 'efficiency' basis. In the studies conducted by the N.I.I.P. into supervision and joint consultation in British industry, a high rate of refusal to permit visits by investigators occurred (only 16 per cent. of firms were prepared even to answer a reply-paid questionnaire), and this sampling bias is frankly stated in the reports of these inquiries. The A.A.C.P. Reports nowhere state the proportion of firms which refused permission for the Teams to visit them. The only published information on this issue is a note by Campbell Balfour in an article, 'Productivity and the Worker' (*British Journal of Sociology,* 4, 1953), in which he reviews the methodological shortcomings in the work of the A.A.C.P. Teams, and suggests that something like four out of five firms approached refused to allow visits. Again, the Team on 'Coal' reports its terms of reference as including "visits to good and bad pits where conditions were as far as possible comparable with those in Great Britain", but after that there is no indication that the Team did in fact visit any 'bad' pits. Moreover, there was every reason for the Teams deliberately to choose to see the most advanced and progressive organisations, for they were out to learn, not to obtain a representative picture of American industry.

Again from the sampling point of view it looks—and the reviewer has not checked this—as if the establishments visited by the Teams were on the whole big ones. For example, the 'Training of Supervisors' Report lists only one establishment visited as employing less than 2,000 people, and in view of the fact that the average size of industrial establishments in the United States is *smaller* than the average size in the United Kingdom this shows a serious bias.

Thus Smuts, although he samples the Reports fairly, seems to this reviewer to be much too uncritical of the methods by which the Teams arrived at their 'impressions of the American worker'. He seems too to have failed to make sufficient allowance for the attitude of mind of the visitors. It must be remembered that the Teams visited the United States between 1948 and 1952; that is, they left this country—particularly the earlier Teams—in a siege economy, with widespread rationing, austerity, and controls on all sorts of economic activities, and they landed in an America which was then at the height of an unprecedented boom. Take for instance the 'Brassfoundry' Report, which is one of the most frequently quoted, not only by Smuts, but also by Graham Hutton in *We Too Can Prosper.* The Brassfoundry Team definitely went overboard in their enthusiasm for the zest, zeal and drive of the American worker, in their acclaim of the high standard of living and the optimistic and expansionist outlook of American workers, managers and Union officials alike. This enthusiasm is noted, but how about the frankly political comments of this Team (which visited the States in 1950)? "Today, five years after the conclusion of a victorious war, Britain is still a land of austerity with an insufficiency of homes, utility clothing, limited food, and five years' delivery of a motor-car on which, as on all luxuries and many necessities, heavy purchase tax is levied. The people are, however, urged to produce more with no other incentive than figures showing how well they are doing or grave warnings of worse conditions to come. There is no real indication of any real drive or intention to relieve their burdens. . . . The introduction of political controversy into the field of industry has dangerous repercussions, making co-operation between management and worker difficult. . . . Small firms, unable to stand the strain of taxation and foreign competition, succumb to the attractive offers of larger concerns. Thereby personal relationships become less and less, and, as in the case of the nationalised industries, a working man has no 'gaffer' with whom he can 'talk it over'." Again, the 'Rigid

Boxes and Cartons' Team (which reported early in 1951) stated: "There is no doubt that diet plays an important part in enabling the American worker to work faster and keep up effort. . . . We might mention that the members of the Team enjoyed much greater energy as the weeks went by and were able to do their arduous job . . . all day without fatigue. In addition they were able to follow without difficulty the American way of life and carry on with the minimum amount of sleep". The 'Grey Ironfounding' Team also comment on diet, higher nervous energy, and being themselves affected, as does the 'Footwear' Team.

These then are criticisms of a failure to admit the sampling deficiencies, and failure to allow for the attitude of mind of the visitors. A third criticism which might be the most damning of all has been anticipated in a curious way by Smuts. The 'impressions' of the Teams are in many ways frankly at variance with the facts as represented by official statistics and by social research workers in the United States. For example, many of the teams say that industrial relations in the States are harmonious and that Unions and workers have given up restrictive practices. The cold statistical fact is that the amount of strikes and industrial unrest has been much *higher* in the States than in Britain. The report of the 'Building' Team admits this and quotes figures which show that the man-days lost through industrial disputes in the American building industry was nearly 100 times as great as in Britain in 1949. Even if we allow for a working population three times as large as that of the United Kingdom, we cannot with these figures support arguments that industrial relations in the States are harmonious. And this is a persistent tendency: the 1953 figures show that the time lost due to strikes in American industry as a whole was over 12 times that lost in the United Kingdom. Again, it does not appear to be the case from the industrial relations literature produced in the United States that harmony, co-operation and wholehearted support of productive efficiency is characteristic of Union-management relationships. The impression one gets from much of the literature is of a tradition of ruthless manoeuvring for power positions, and a full deployment of all the tricks of highly competitive bargaining. (See, for example, *Successful Labour Relations for Small Business*, by J. M. Black and J. G. Piccoli, McGraw-Hill, 1953; and *Goals and Strategy in Collective Bargaining*, by F. H. Harbison and J. R. Coleman, Harper, 1951.) Smuts recognises this fact and suggests that it is *because* of the discrepancy that the A.A.C.P. Reports provide such a valuable mirror in which Americans can see themselves as others see them. One can sympathise with this point of view, but it seems a very dangerous procedure to use a distorting mirror without admitting that the image is likely to be seriously and systematically biased—and particularly that the glass is rose-tinted.

The second important question for British readers is what lessons can we draw from the Reports and from this summary of them. Smuts sets out to draw together the implications of the Teams' comments about the human factor in American industry. This he does well, but, as has been suggested above, without a sufficiently critical attitude to their shortcomings. However, there is a secondary theme, that the picture of the zestful, energetic and hardworking American is to a large extent true and that it is one of the prime reasons for the superiority of American industrial productivity. (Graham Hutton does the same thing.) This seems to this reviewer to be a highly dangerous argument. Hawthorne experiment or no Hawthorne experiment, productivity differences of more than 100 per cent. between the averages of whole nations do not seem to be reasonably attributable mainly to attitudinal differences. Moreover, the facts do not support this interpretation.

There are large national differences in the productivity of industries on the two sides of the Atlantic. The most convincing presentation of the statistics is given by L. Rostas in *Comparative Productivity in British and American Industry*, Cambridge University Press, 1948. But these differences vary from industry to industry. For example, productivity in coal mining in the United States is four times that of the United Kingdom. This very large difference was attributed in the Reid Report very largely to the easier geological conditions of American mines. The average productivity of manufacturing industry in the United States is something over twice the United Kingdom figure (1935-1939 figures). But United States non-manufacturing industries do not have anything like this lead; in agriculture there is hardly any difference, in building and construction the United States leads by about 25 per cent., in fisheries the United Kingdom leads by about 25 per cent., in finance there is no difference, in distribution the United States leads by about 25 per cent., and so on. Now, if the 'social climate' of the United States were responsible for the large productivity differences in manufacturing industry, it is difficult to see why the non-manufacturing industries should not be equally affected. Moreover, there are certain factors such as the extent of mechanisation—*e.g.*, the American worker in manufacturing industry has more than twice as much mechanical horse-power at his disposal—which are more closely associated with the industry by industry productivity differences than are any postulated attitudinal differences. Again, marketing conditions in the United States are very different from those in the United Kingdom — for example, as the 'Internal Combustion Engines' Team remarks: "One of the main differences between the Internal Combustion Engine industry in the U.S.A. and in the United Kingdom is that over 90 per cent. of the total current output from the British plants is exported and about 90 per cent. of the output from the U.S.A. is for home consumption". This fact of a huge and apparently insatiable home market applies to many branches of manufacturing industry, and has encouraged a notably higher level of standardized mass-production in America. Again the American economy has not been strained to the same extent as British economy: it has not had to deal with the acute shortages of raw materials and manpower that have been the lot of Britain. On the manpower question it is worth recording that the unemployment level in the States has been something like twice the United Kingdom rate for many years, and this has provided not only a margin for industrial expansion but can also be presumed to have had an effect on the attitude of the industrial worker; as the 'Internal Combustion Engines' Team says: "Labour is plentiful and it would appear that fear of dismissal is certainly one reason for the high standard of effort that was observed in most factories". Similarly the 'Men's Clothing' Team: "A vital factor contributing to American productivity is the composition of the labour force which differs greatly from that of the British clothing industry in age and experience and in the balance of the sexes. In the United States the general age level, and consequently the skill and experience of the workers is high".

These provisos should not be taken as an attempt to diminish the seriousness of, nor to excuse, the fact of lower United Kingdom productivity, but the matter is far too serious to permit the acceptance of impressionistic diagnoses of the causes. The A.A.C.P. Reports provide an enormous amount of valuable information—much of which serves, after careful scrutiny, to permit at least the exclusion of certain reasons for the higher output per operative in the United States. For example, it does not appear to be the case that more widespread use of incentive methods of payment can account for the differences. Recent figures indicate that something like 35 per cent. of American workers are paid by incentive methods, in comparison with something like 32 per cent. of British workers. It is worth noting that the 'Footwear' Team report that about 95 per cent. of workers in the American footwear industry are paid by results, in comparison with about 50 per cent. of workers in the British footwear industry, but American productivity in this industry appears to have *declined* from an index of 185 in 1945 to 139 in 1949, while it has *risen* from an index of 100 in 1945 to 110 in 1949 in the British industry. The Report of the 'Building' Team indicates, despite careful qualification about the difficulties of finding comparable productivity indices, . . . that "the output per man-hour on similar site operations is approximately 50 per cent. higher in America than it is in Britain". But on the next page of the same report figures are given which indicate that costs in America vary, according to the type of building, from about 50 per cent. to about 80 per cent. *above* those in Britain. Thus although higher wage rates, more mechanisation, and a higher proportion of workers engaged in planning and supervision do increase the speed of building, they also increase the cost. Moreover the high wage rates in the American building industry—average annual earnings $3,131, as against average for all United States industry of $2,809—is associated with considerable competition to enter the industry and permits employers to be highly selective in accepting candidates. This fact alone seems strikingly unlike the British position.

Again, there is a tendency for the Reports to instance the high material standard of living in the United States as a source of its high industrial productivity. While the 1950 circumstances no doubt greatly favoured the United States in comparison with austerity Britain, the pre-war position was not enormously different, despite the fact of much higher industrial productivity in the States. Rostas indicates that the average American standard of living (in 1937) was not much higher than the British standard—possibly a lead of some 25 per cent.—and that the disparity between the much higher industrial productivity and the only slightly higher standard of living could be accounted for by such facts as that a higher proportion of the population of the United Kingdom was at work (for example, proportionately many more British than American women were wage earners), a higher proportion of the American population was engaged in agriculture, hours of work in America were shorter, and so forth. It is to be hoped that the glamourised stereotype of the U.S.A. as a land of riotous materialistic wealth will not be unreasonably extended by selective quotation from the Reports of the Productivity Teams. There is already some reaction in Europe against the materialism that is thought to characterise American civilisation: indeed, there is a good deal of reaction against it in America itself, if American novelists can be regarded as accurate commentators.

On the question of Trade Unionism, Smuts has much of interest to contribute. It is well recognised that the Trade Union organisation in Britain has certain features markedly unlike those of the United States—the greater decentralisation of American union organisation as instanced by the Union-Plant contract in place of national agreements is probably the main example. As Smuts puts it: "On the surface . . . industrial relations in Britain are relatively harmonious and placid. In place of the American pattern of innumerable, hard-fought negotiations between local union officers and individual managements, both with a strong personal stake in the outcome, the British pattern is dominated by a handful of relatively impersonal industry-wide conferences . . . there is a common understanding that little of consequence will be attempted without prior consultation and agreement". He suggests that this relative placidity is bought at the expense of flexibility and willingness to change. "They (the Teams) perceived, with a note of envy, that the element of conflict in American industrial relations may be taken not as a sign of fundamental class antagonisms, but rather as an indication of the willingness of organized labour to tolerate change and work out the inevitable differences. . . ." Few people in Britain can be entirely happy today about the effectiveness of our industrial relations machinery, but one wonders whether more widespread decentralisation really has much to offer, at least without a period of probably bitter strife while the 'local' negotiators gained experience and mutual tolerance. After all, the U.S.A. appears to have found central control through the Taft-Hartley Acts desirable in an attempt to stem the rising tide of cut-throat local bargaining.

One final criticism may be made. Smuts's title suggests that it was the 'worker' in America who produced the most definite impression on the visitors. This reviewer is impressed much less by the A.A.C.P. Team's comments on the American 'worker' than by their comments on American management. It is time to say bluntly that in the majority of cases the 'worker' has only very limited control on productive efficiency—the really big gains come from improved working methods, planning for long runs, steady supplies of materials, mechanisation and good markets. That improvements in these areas can only be achieved through co-operation between 'workers' and 'non-productive staff' is becoming a trite observation, but, from attitude surveys carried out in several British factories in the last few years, this reviewer has some reason to suspect that there is less resistance by 'workers' to the application of work study, and a much greater willingness to try new ideas than either management or Trade Union officials often seem to believe. There is a danger of overdoing 'the human factor' both by regarding it as highly resistant to technological change and in regarding it as the main key to high productivity. Management, methods, machines, materials, markets, manpower, and morale are all important in relation to productivity—and they all deserve equal consideration. It is one of the dangers of summarising reports like those of the British Productivity Teams that, in the search for themes common to all the Reports, the technological detail relating to specific industries gets omitted, and the emphasis is swung far too heavily on to 'the will to work'.

Despite these criticisms, this reviewer strongly recommends this book. It is extremely well written, informative, provocative, and short. JOHN D. HANDYSIDE

Psychiatric Treatment. Research Publications: Association for Research in Nervous and Mental Disease. Vol. 31. Various authors, edited by S. B. Wortis, M. Herman and C. C. Hare. London: Balliere, Tindall & Cox. Pp. xiv + 451. Price 68*s*. 6*d*.

This volume, which is the latest in a distinguished series, contains thirty-four papers on different aspects of psychiatric treatment. The papers are arranged to make eight symposia. Four of these are concerned with individual and group psychotherapy, one with insulin and electrical treatments, one with drug treatments and two with neurosurgical treatments. Each symposium ends with a brief summary and discussion, but no attempt is made to provide a synopsis, and the papers stand more or less on their own, with no more than a tenuous relationship to a central theme. Nevertheless, as representatives of contemporary research contributions of at least average quality, they provide together a vivid picture of the current trends in treatment.

This is not an easy book for laymen, although it deserves to be read by them. Its purpose is to record the proceedings of a conference of psychiatrists at which work in progress was discussed trenchantly and criticised courageously. Most of the papers deal with controversial issues. Discordant views are not reconciled. What is common ground receives little attention. However, those laymen who suspect psychiatrists of complacency will gain from the discovery that the criticisms which psychiatrists make of each other's work are at least as forceful and penetrating as, and sometimes more informed and more pertinent than, the criticisms which psychologists tend to make. The several psychiatrists, for instance, whose papers discuss the results of various treatments, and the methods of assessing them, have nothing to learn from, and something to teach, those psychologists who from time to time question and cast doubt on the value of one or other kind of treatment.

What does psychiatric treatment achieve in the saving of life, the relieving of distress and the reducing of disability? This question, which is repeated throughout the volume in various forms, is not easily answered. As their papers show, psychiatrists feel very keenly the obligation to provide the evidence on which to base the answer, more keenly perhaps than do physicians and surgeons in their branches of medicine. Psychiatrists have been urged to refer to objective criteria, to compare the results of treatment with the results obtained in control groups, to express results in quantitative terms and to apply statistical tests. In some instances they have done all these things; *e.g.*, there is satisfactory evidence to show that, in the treatment of the psychoses, both ECT and insulin-coma treatment, appropriately applied, reduce the not inconsiderable mortality rate (due to physical exhaustion, inanition and suicide) and shorten the period of hospitalisation. Yet those who treat patients, whether physician, surgeon or psychiatrist, tend to attach less importance to such evidence than they do to opinions based upon clinical experience. They regard observations made at the bedside as more relevant, although less systematic and less objective. Amongst the contributors to this volume are to be found both supporters and opponents of this viewpoint. There is much to be said on both sides. D. RUSSELL DAVIS

Psychoanalysis and Personality. By JOSEPH NUTTIN. London: Sheed and Ward, 1954. Pp. 275. Price 16*s*.

"Psychoanalysis", writes Father Nuttin, "reduces all dynamic activity to *impersonal* forces, so that man is dominated by the vital, unconscious force of the 'id'; he does not govern or dispose of himself at all. Traditional psychology, on the other hand, concentrated on the other aspect of this dynamic activity and represents self-determination, or the conscious will, as a force which can govern human conduct in sovereign fashion absolutely. The real dynamism of human behaviour is, in fact, a varying combination of all these components, biological and spiritual, conscious and unconscious, known or disguised". This quotation illustrates the character and the shape of the book, which begins by a criticism of psycho-analysis, passes into a discussion of freedom and morals and concludes with the attempt to elaborate a 'dynamic theory of normal personality'. Father Nuttin is wise and scholarly, and avoids the glibness of 'agreeing with Freud's psychology, but not with his philosophy'. His examination of psycho-analysis is calm and careful, and his objections are not ideological, but logical. Indeed, he goes almost too far in the pursuit of objectivity, consistently writing more as psychologist than as priest, though a clearer statement of his views on psychological manifestations of the spiritual or supernatural would have been extremely interesting.

Father Nuttin's main purpose is to sketch a scheme of personality development which is more than the 'fragmentary contribution' which Freud himself held psycho-analysis to be. He considers personality growth in terms of a series of interacting needs at the biological and social levels. He concludes that: "Man *is*, and 'feels' himself (implicitly, perhaps, but fundamentally) to be both a *self-subsistent being*—hence the drive to self-preservation and self-development — and *a being essentially linked to others* — hence the 'natural' need to seek contact with everything that maintains and continually 'feels' his existence. This complex double tendency—towards self-development and towards contact with others—which enters to some extent into the whole of human activity, can therefore be considered the *dynamic expression, on the psychic level, of what man is*. Hence follows the intimate fusion of these two needs (in the fact that it is *in* and *through contact* with 'others' that man *maintains* and *develops* himself): since they are simply manifestations of two complementary aspects of his single being: he is a *being in himself who nevertheless derives from, and depends intrinsically upon, others*".

These conclusions are not all inherently different from those reached by psychoanalysis, although as developed by Father Nuttin they allow for the intrusion of spiritual factors ignored by the orthodox Freudian. Nevertheless the place of the unconscious is perhaps unnecessarily played down, and the least convincing arguments turn on our assumption that when Freud spoke of the unconscious as belonging to the 'second state of consciousness', he meant something rather different from the unconscious as it is generally understood. But in so rich and subtle a book, it is unfair to pick on any one line of reasoning, since all are interwoven to produce a pattern which is both stimulating and, in the main, convincing.

ADAM CURLE

Appraising Personality. By MOLLY HARROWER. London: Routledge & Kegan Paul, 1953. Pp. xviii + 198. Price 18*s*.

This book is written for the purpose of helping physicians and others concerned with human personality, but not familiar with the principles of psychological testing, to glean some insight into reports submitted by psychologists. It is not in any way a manual for the use of psychologists wishing to administer tests.

An introductory chapter gives a general account of the function of the psychologist in the clinical picture, and shows illustrative charts of the psychological findings of various persons referred for testing, together with the psychological diagnosis. Later chapters in Part I discuss the general principles of testing, and in particular the function of projective techniques, and the misunderstandings which can occur on the part of the uninitiated. The second part of the book gives some account of the individual tests and the sort of conclusions which can be drawn from them by the clinical psychologist, with illustrative material of the tests and charts showing various psychological disturbances. The tests discussed are Rorschach Ink Blots, Wechsler-Bellevue Intelligence Scale, Drawing a Person, Drawing "The Most Unpleasant Thing", the Szondi Test, and a Sentence Completion Test. The third part gives illustrative case studies and psychological reports.

The book is written in simple, non-technical language, and the illustrative material is well chosen and adequate to give some insight into an interesting technique without being so detailed as to become burdensome or to tempt the uninitiated into carrying out his own interpretations. It is written in the form of a dialogue between a physician and a psychologist, which gives it an unnatural tone. The questions asked and comments made by the physician add nothing to the knowledge or understanding of the reader and give an impression of artificiality. A straightforward exposition of the subject would have been easier reading and would have saved space. However, the book should prove of value to those who are seeking enlightenment in a field of ever-growing popularity and in which there is much misunderstanding. M. B. STOTT

Who Shall Survive? By J. L. MORENO. Second Edition. New York: Beacon House, 1953. Pp. cxiv + 763. Price $10.

The first edition of Moreno's book appeared in 1934 and has become familiar to people in this country who are interested in techniques of studying social groups. The value of its contents rests at this technical level, despite the flourish of the book's title: in devices such as sociometry, sociodrama and role-playing, methods of applying group therapy or of studying the forces operating in social groups. If these techniques have not been greatly used in industry in this country, it is perhaps because of their apparent naïveté, to some extent (but not entirely) deceptive. Their impact upon industry here has therefore been rather oblique; for example, they tend to be part of the armoury of psychiatrists concerned with industrial rehabilitation, or of those people who study methods of teaching other people how to train supervisors in industry.

On meeting the second edition, the questions which immediately come to mind are: What has been added to increase the first edition of xvi + 437 pages to the cxiv + 763 of the second? Should one recommend the abandonment of what has occupied 1¼ inches of shelf-room in favour of an edition which demands 2¼ inches, and at no small price? Useful additional material is difficult to find. There are new and elaborate tables and charts, for the most part re-presentations of old data (in one case, different results from apparently the same study); there is surprisingly little fresh empirical data. The bibliography has spread from one page to 31, mainly it would seem by the addition of papers which have appeared in the journals which followed the first edition, *Sociometry*, *Sociatry*, etc.

The nature of much of the additional wordage can best be seen in the so-called Preludes, which occupy nearly a hundred introductory pages. In them, we are given a history of the 'sociometric movement', which is described as a new sort of religion modified by science. "The genesis of psychodrama was closely related to the genesis of the Godhead." "If God were to come to earth again he would come as a group, a collectivity, not an individual." Elsewhere, *Who Shall Survive?* is described as a bible. "It has more ideas packed into one book than a whole generation of books." But Socrates was 'the closest to being a pioneer of the psychodramatic format'. And group psychotherapy sprang, we are told, from a wish to do for prostitutes what Marx had done for the working classes, to make them respectable and give them dignity.

Eclectics in this country may be abashed at the attacks dealt out here. Freud is criticised liberally (although Anna Freud and Melanie Klein apparently found acceptance because Moreno had established a 'receptive climate for them'). One of the sub-headings of the Preludes is '1931, The Passing of the Psychoanalytic System'. The cause of death was apparently Moreno's intervention in a conference at which Brill was reading a paper. Freud's system is attacked graphically: "Freud looked at man from below; he saw man 'upside down' and from the position from which he looked at man he saw first his sexual organs and his rear." However, psychoanalytic techniques are described as having fallen into place in the sociometric system. Also criticised, particularly as imitators, are Korzybski, Lewin and the whole Group Dynamics movement and Bales. Moreno claims that his own system influenced the Sullivan group and the Hawthorne Experiment.

A further subheading asks: '1950, Why Did I Run for the Presidency of the American Psychiatric Association?' Two answers are given, that hitherto the association had had for a President neither a Jew nor a genius.

"Behind the histrionic stylist of the Preludes", Moreno tells us, "is an humble man". It may seem inappropriate to dwell so long on this autobiographical section, but it may help to allay his own fears, expressed at the conclusion of this section: "Now I fear only that many will read the Preludes and not the book".

The expansions in the text of the book are largely of this same dream-like character, disjointed, wildly speculative, grandiose and critical of other theorists in the social sphere.

With the possible exception of a half-page account of the sociometric test and the sociometric questionnaire on p. lxxi of the Preludes, no straightforward account of what sociometry does occurs until p. 81 (*i.e.,* after any reader with the habit of reading straight through a book has read 180 pages). A reader with little previous knowledge of sociometry will by this time be thoroughly bewildered. Having been dragged through a fantastic maze of strange speculations, he will be in danger of having built up an expectation of blind alleys only, just as he reaches the point, which is roughly where the first edition began. In fact, the great advantage that the first edition has over the second is that its presentation does allow one to appreciate Moreno's achievements, whereas the second chiefly demonstrates how far short they fall of his aspiration, which appears to be nothing less than the re-creation of the universe. It is a long step from the study of girls living in cottages with housemothers to the following claim: "The simultaneous applications of revolutionary sociometric methods in the United States as well as in Soviet Russia might bring about a rapprochement between the two types of government. The revolutions of the socialistic-marxistic type are outmoded; they failed to meet with the sociodynamics of the world situation. The next social revolution will be of the 'sociometric' type". The next American evangelist for Harringay? But Moreno assures that he has no illusions as to his own importance: "I am fully aware that sociometry might have come into existence without me, just like sociology would have come into existence in France without Comte, and Marxism in Germany and Russia without Marx".

THELMA VENESS

Construction of Esso Refinery, Fawley: A Study in Organization. By A. P. GRAY and MARK ABRAMS. London: British Institute of Management, 1954. Pp. 39. Price 3*s.* 6*d.*

This is an exciting story, well told. The £37½ million refinery on Southampton Water was officially opened six months before the date originally set for completion. It was built by British workers operating under American management. It was a tremendous achievement as the authors, both of Research Services Ltd., say, and they have tried to apportion praise fairly. They acknowledge at the outset the favourable external circumstances, namely, the backing of the British Government which meant that priorities for materials could be obtained; the availability of dollars for buying materials and equipment in the United States—and the existence, at the time, of the required materials. (There were, however, several unfavourable circumstances, including bad weather and shortage of skilled labour.) They list sixteen "managerial and organizational functions which contributed to the speedy construction of the refinery". These can be re-summarised: for the major part of the job, the employment of one main contractor, Foster Wheeler Ltd., who worked in very close co-operation with Esso, and who negotiated all contracts and labour problems with *one* Union; really efficient planning of everything down to the smallest detail and energetic action when the plans were held up; a high standard of supervision, mostly American. I am sure the authors would agree, from the evidence of their own report, that a seventeenth factor which contributed to the success of the undertaking was the personality of Bob Cole, the Project Manager. He seems to be a remarkable man.

Of the many interesting features of the report I have space for only two. First, the British workers seem to have worked well under American management and supervision. The net result of the operation shows this, but, in addition, the investigators went to some trouble to discover how the British workers felt about it. Apparently, the majority liked and respected their supervisors, applauded the way they 'mucked in', their absence of 'snootiness', their helpful rather than critical role, and their almost continuous presence on the site rather than in an office. The Americans' informality, their language, wisecracks and bizarre dress were all commented on and seemed to have helped create, and keep, a pleasant working atmosphere.

Another feature of the project was the single Union (Confederation of Shipbuilding and Engineering Unions), so negotiating was streamlined. This enabled the Union and the Project Manager to agree on one flat rate of pay for all skilled craftsmen, another for all general labourers and an intermediate rate for men who learned to handle specialised equipment. *There were no piece rates or bonuses.* The local Union secretary thought that this agreement was very important in reducing discontent and envy among the workers and believed that it was the key to success at Fawley.

It is, as Gray and Abrams point out, impossible to discover from this investigation scientifically valid answers to questions which trouble British industry today. What *would* be possible is to carry out similar investigations into comparable constructional projects in Great Britain. No philosopher's stone would result from such investigations but we would perhaps be in a stronger position to evaluate the tentative findings of this report. Meanwhile, all those who are concerned with, or about, British industry will find the report a stimulus to thought—and possibly action. DENIS MCMAHON

The Making of a Scientist. By ANNE ROE. New York: Dodd, Mead and Company, 1953. Pp. ix + 244. Price $3.75.

This slight and conversational volume recounts the adventures of Dr Roe in studying the background and personality of sixty-four of America's most eminent research scientists. There is little doubt that Dr Roe was both enthusiastic and thorough. Her subjects were carefully selected from the biological, physical and social science fields, and the author read some of their works, interviewed them and employed cognitive and projective (T.A.T. and Rorshach) tests. Twelve of the sixteen chapters are concerned with these stages in the study and the author's conclusions. There is one chapter on a subsidiary and less thorough study of 382 scientists in the same three fields, two introductory chapters and a final orientation chapter.

Dr Roe's decision to report her research in a popular form appears to have been influenced by the nature of the results and a desire to assure the public that clinical psychology has 'nothing up its sleeve'. The result is a mixture of oversimplification and obscurity. Dr Roe's conclusions are not supported by significant evidence. They are, rather, suggestive interpretations that may be misleading for the layman, for whom the book is written. The chapter on the use and results of the cognitive tests, for example, explains such concepts as those of the I.Q., standard scores and median scores in order to cast light on the subsequent calculations and comparisons. These latter, however, are so beset with qualifications and statistical limitations as to have little meaning and to leave the reader with the feeling that he has been symbolically deceived. There are other more serious inadequacies in Dr Roe's use of test data, but these may be due to the level of simplicity which she has elected to use in her writing.

While the problem that Dr Roe states on the first page—'what kinds of people do what kinds of scientific research and why and how and when'—remains largely unanswered, there are several suggestive indications from the evidence into which further research might well be undertaken. The processes of thought of different scientists, their motivational patterns and the effects of family relationships on subsequent success are all fascinating areas for exploration for the vocational and clinical psychologist. The consistent evidence of the haphazard way in which most of the scientists in this study entered their particular field of work raises relevant problems for the educational psychologist.

Dr Roe's book, then, provides a useful stimulus for further work, but its limitations in literary style and experimental rigour preclude it from a permanent place in the serious research workers' bookshelf. The general reader should find it entertaining and provocative.

PETER REEVE

Irish Management, Vol. I, No. 1. January-February, 1954. Cork: Mercier Press. Price 1*s*. (Annual subscription 6*s*. 6*d*.)

The problems of management are, no doubt, in essentials, common to all modern industrialized societies, but nothing but good can come from these problems being studied with reference to local needs. This new periodical is therefore a welcome addition to management publications. It is the bi-monthly journal of the Irish Management Institute, a recent foundation dating from December, 1952. Though local, it is by no means insular in its interests. In the reports of the proceedings of the Institute we may read the names of very many men known in management circles throughout the world. The first conference of the Institute—on Training, held in Cork in 1953—seems to have been a model of well-balanced representation. Industry, the Universities and the vocational education authorities contributed in appropriate proportions.

Occupational psychologists will note with satisfaction that the first main article in the journal is on *Psychology and Industry*. Its writer is Dr Peter Dempsey, who is best known perhaps as the author of an original and penetrating work on the philosophy and psychology of Jean-Paul Sartre. Here he seems to be equally at home with his feet firmly on the ground, explaining what Irish industry can learn from Taylor, Fayol and Mary Parker Follett. His thesis is that the greatest single problem of Irish industry is not economic but psychological. In agreement with the Ibec report, he believes this problem to be one of enhancing confidence. Merely to establish this fact might go a long way towards providing the solution; for the Irish must surely be getting a little tired of being told that their country is poor in mineral resources, limited in its home market, and lacking industrial traditions—and therefore, it might seem to be implied, predestined to eternal poverty. How confidence is to be gained, Dr Dempsey will perhaps tell us in the next instalment of his paper, which will appear in the second number of the journal.

The issue also contains an interesting article on *Training the Worker* by E. M. Gray (Director of the Personnel Group of the Cotton Board) and a 'Special Feature' article on the Metal Spraying Industry, together with reports, news and reviews. If the high standard of the first number is maintained the future of this journal should be assured. It is certainly a journal to keep one's eye on.

C. A. MACE

Other Books Received

The following books have been received. Their inclusion in this list does not preclude their review later.

The Social Psychology of Industry: Human Relations in the Factory. By J. A. C. BROWN. London: Penguin Books, 1954. Pp. 310. Price 2*s*. 6*d*.

"Rehabilitation." Spring, 1954. London: The British Council for Rehabilitation. Pp. 1-32. Price 2*s*.

Youth Work in England: extracts from Ministry of Education and other publications relating to Statutory and Voluntary Youth Work in England. Compiled by P. H. K. KUENSTLER. University of Bristol: Institute of Education Publication No. 6. London: University of London Press, 1954. Pp. 128. Price 4*s*.

Industry at the Bargaining Table: Critical Factors in Contract Negotiation. AMERICAN MANAGEMENT ASSOCIATION PERSONNEL SERIES No. 156. New York: A.M.A., 1954. Pp. 52. Price $1.25.

Management at Mid-Century: Business Leadership's Obligations and Opportunities. AMERICAN MANAGEMENT ASSOCIATION GENERAL MANAGEMENT SERIES No. 169. New York: A.M.A., 1954. Pp. 32. Price $1.25.

Building a Balanced Communications Program, with a Paper on the Evolving Picture in Labour Relations. AMERICAN MANAGEMENT ASSOCIATION GENERAL MANAGEMENT SERIES No. 170. New York: A.M.A., 1954. Pp. 44. Price $1.25.

Les Tests Mentaux. By PIERRE PICHOT. Paris: Presses Universitaires de France, 1954. Pp. 128. Price not stated.

Aids to Educational Research, comprising Bibliographies and Plan of Research. Revised Edition. SCOTTISH COUNCIL FOR RESEARCH IN EDUCATION. London: University of London Press, 1954. Pp. viii + 42. Price 2*s*. 6*d*.

Psychological Testing. By ANNE ANASTASI. New York: Macmillan, 1954. Pp. xiv + 682. Price $6.75.

The Vocational Aspect of Secondary and Further Education. Edited by A. J. JENKINSON and W. A. SKINNER. Vol. VI. No. 12. Spring, 1954. Published from the Training Colleges at Bolton, London and Huddersfield. Pp. 1-80. Price 5*s*.

The Later Working Life in the Building Industry: A Study of 320 Ageing Maintenance Workers. By F. LE GROS CLARK. London: The Nuffield Foundation, 1954. Pp. 22. A limited number of copies available free of charge.

Transference: its meaning and function in psychoanalytic therapy. By B. WOLSTEIN. New York: Grune & Stratton, 1954. Pp. xvi + 206. Price $5.00.

A Synthesis of Human Behaviour: An Integration of Thought Processes and Ego Growth. By J. C. SOLOMON. New York: Grune & Stratton, 1954. Pp. xiv + 266. Price $5.50.

Ergonomics Research Society Proceedings Vol. 2. Symposium on Human Factors in Equipment Design. Edited by W. F. FLOYD and A. T. WELFORD. London: H. K. Lewis, 1954. Pp. viii + 132. Price 21*s*.

Patterns of Error in the Addition Number Facts. By J. M. THYNE. London: University of London Press, for the Scottish Council for Research in Education, 1954. Pp. xx + 276. Price 10*s*. 6*d*.

The Worker in Modern Industry. By NIGEL BALCHIN. London: Institute of Personnel Management, 1954. Pp. 14. Price 2*s*.

Self-Perception in the University. By E. Z. FRIEDENBERG and J. A. ROTH. Chicago: University of Chicago Press, 1954. (London: Cambridge University Press.) Pp. x + 102. Price 13*s*. 6*d*.

OCCUPATIONAL PSYCHOLOGY

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The Measurement of Occupational Aptitudes in a Multi-Racial Society

By S. BIESHEUVEL

Dr Biesheuvel is Director of the National Institute for Personnel Research, South African Council for Scientific and Industrial Research, Johannesburg. In this paper, which contains the substance of a contribution to a symposium on "Individual Differences in Ability and their Implications for National Policy" at the Fourteenth International Congress of Psychology, held in Montreal in June, 1954, he comments on problems, policies and recent practices in the Union of South Africa.

THE OCCUPATIONAL STRUCTURE OF SOUTH AFRICA AND ITS EFFECT ON THE MEASUREMENT OF APTITUDES

At the time of the last Census, taken in 1951, the population of the Union of South Africa numbered 12,646,375 people, of whom 20.9% are of European descent, 67.5% are Bantu-speaking Africans, 2.9% are Asian and 8.7% are of mixed origin.

For reasons of social policy, restrictions are imposed by statute, custom or both, on all non-European groups, but particularly on Africans, the general effect of which is to debar them from entering skilled trades or from performing higher level administrative, clerical and professional duties, except where these are carried out on behalf of their own people. Political developments in the future may lead either to a closer economic integration of the two races, in which case the removal of labour restrictions on Africans will be unavoidable, or to a gradual unscrambling of the mixed labour force, with separate development of Africans in their own tribal areas. Whatever happens—and the nation is divided about the wisdom of the former and the practicability of the latter policy—it is clear that for many years to come the white population will be called upon to produce a disproportionate number of people with high-grade technical, administrative and professional ability, perhaps from four to five times as many as the populations of Western Europe and North America must yield to maintain their national economies (Biesheuvel, 1952).

The resulting occupational structure would appear to favour the study of individual differences in the white population, where there is obviously a paramount need to make the best possible use of the available manpower, whilst there would seem to be little point in assessing the potentialities of non-Europeans in view of the limits imposed on their development. Actually the reverse turns out to be the case. In the white group, individual differences are cut across by lack of industrial experience and tradition and by attitudes which derive partly from long-established race relations, partly from a pastoral, almost nomadic rural culture. Under these conditions, aptitude testing is clearly less pertinent than research into training methods, motivation and industrial morale, the causes and prevention of absenteeism and labour turnover, and the building up of managerial skill.

In the African group, significant work attitudes are also making their appearance. These differ according to the origin of the worker and they are already influencing his choice of work, his motivation and his competence. But their immediate effect on productivity is less marked than that due to differences in ability, concerning which the employer is not provided with any obvious clues. The African population is not clearly stratified according to education, socio-economic status, or caste. A majority of adults, particularly those drawn from the tribal areas, are illiterate or have achieved only a low standard of education. Previous employment may be more a matter of expediency than of competence, and parental occupation is a guide in only a small proportion of cases. Hence employers are anxious to make use of personnel selection tests to determine the basic abilities of work-seekers.

APTITUDE TESTS FOR AFRICANS

In the construction of tests to meet this need, no attempt was made to appraise the abilities of Africans as they would have been had they enjoyed the same environmental opportunities as the average white South African. For practical purposes, the African had to be considered as he was here and now, a product of social circumstances the effects of which will continue to make themselves felt for a long time to come. As the majority of jobs open to Africans are of the unskilled, semi-skilled and operative type, the aim was to construct a general adaptability test that would indicate how readily and up to what point a work-seeker was trainable on the job. In view of the prevalence of illiteracy among tribal Africans, their unfamiliarity with the use of pencil and paper and the many languages and dialects spoken by them, it was decided to use performance tests applicable in the mass. A new method of administering these tests through the medium of a silent motion picture was devised, in which the candidates are introduced to the testing procedure and its conventions, the test assignments are explained to them, and correct and wrong responses are demonstrated by means of mime. This method proved entirely successful, even in the case of primitive Central African tribesmen. The tests that gave the best score distributions and that were retained in the all-purpose battery were a series of four specially constructed formboards; adaptations of the Cube Construction, Kohs Blocks and Wiggly Blocks Tests; two sorting tests, one of which involved 16 different types of small mechanical objects, the other 16 different combinations of letters and digits stamped on brass discs; a mechanical assembly test; a mechanical pegboard; and an associative learning test. The battery is preceded by a buffer test in which nuts have to be turned on bolts of various sizes. The apparatus was designed for mass production and to be cheap yet durable in use (Biesheuvel, 1952a).

In the gold mining industry, the tests are used as a screening device to classify newly recruited labour into mechanical operative, mechanical constructive and non-mechanical groups. For this purpose, a battery of only four of the tests was found to be necessary. In the mechanical groups, those with previous mining experience are thereafter given leaderless group tests to select candidates for training as boss boys (gang overseers). Here use is made of a kind of pidgin Zulu, universally used on the mines, as a means of communication within the group and between the group and the testers.

The principal results of a large number of validation studies are as follows: Training wastage for boss boys was reduced from 17% for current selection methods to 3%, the estimated wastage for chance selection being 36%. Multiple correlations between boss boy training results and the combined screening and leadership batteries, corrected for criterion unreliability, range from .73 to .51, with the median at .65 (criterion sample 218, reference populations on screening and leadership tests 2,629 and 781 respectively). For ratings of job efficiency (reliability of scale .84) the uncorrected validity coefficients range from .75 to .26, median .44 ($n=47$). For winchdriver trade test results (reliability of test .73) the range is from .68 to .53 uncorrected (n = 312). It is interesting to note that in selecting winchdrivers a battery of individually administered psychomotor tests does not improve sufficiently on the results obtained by means of the simple screening battery to make the cost and bother of its use worth while, the respective validity coefficients being .63 and .71, combined battery .74, which gives a negligible gain in selective power at the particular cut-off point used (Mkele, 1953).

The labour situation in the gold mining industry lends itself particularly well to the use of psychometric manning procedures, as the majority of the 300,000 Africans employed by the industry return to their rural homes for periods averaging 6 months between tours of duty of from 8 to 10 months. Cut-off points have thus been set on the various batteries, adjustable for seasonal fluctuations in the amount and quality of recruited labour, which will yield the operational requirements of various categories of labour as fixed from time to time, due allowance being made for training wastage and refusals. The test battery has found general acceptance and is in use at 14 selection centres, serving 25 mines in the Transvaal and the Orange Free State. It has also been introduced in two mines on the Copper Belt in Northern Rhodesia.

The application of the battery to African operatives in industry is being studied. So far, the tests have been found valid for production-line workers in a motor assembly plant, for workshop and operating personnel in a public transport corporation and for operatives in the building industry.

The test battery has been twice factorised, first on a group of 480 mine-workers, and thereafter on 258 motor assembly operatives, the object being to determine whether the tests do in fact measure general adaptability, or whether their validity derives from their measurement of the various perceptual and manipulative skills which Africans are required to use in the work situation. The range and median of the intercorrelations for the two samples were respectively .58, .18 and .44; .60, .28 and .45. In both cases an unrotated general factor, accounting for about 45% of the variance, was obtained, with substantial loadings in all the tests, the range and median loadings being respectively .74, .51 and .69; .78, .59 and .66. Both analyses also produced a doublet for the two sorting tests and no other significant factors. The highest loadings in both cases being in Formboards and Kohs Blocks, the general factor can best be interpreted as " practical general intelligence ". This interpretation fits in with our finding that regression weights for the tests and hence the composition of the battery chosen for a particular industry change from one validation to another, but that there is no relationship between particular combinations of tests and specific job requirements. Either the jobs for which Africans are being considered and trained merely differ in the amount of general intelligence and general practical ability required to master them, or the large variations in respect of these two attributes in the very heterogeneous population to which the tests have been applied tend to obliterate the effects of more specific skills that may be involved in some of the tests. The intention of measuring adaptability in relation to occupations of a manual, semi-skilled or skilled kind would thus appear to have been realised.

OTHER USES OF THE AFRICAN ADAPTABILITY TEST

The use of the African Adaptability Test is by no means limited to the utilitarian purpose of selection for operative work. Opportunities for vocational training, though steadily increasing, are small in relation to the total number of Africans that could take advantage of them. It is therefore important that the best possible use should be made of the available facilities. A large failure rate would also confirm prevalent doubts about the suitability of all but a small number of Africans for technical training and skilled or responsible work. This would cause a setback to the policy of gradual advancement that is now being pursued in the Union of South Africa. With knowledge of age, sex, education and occupational influences on test performance that are now being studied in large samples, the Adaptability Test will be able to serve as a screen, applied towards the end of the primary school, for grading pupils into groups for immediate employment, for vocational training or for further academic schooling. For certain purposes the battery will of course need to be supplemented by tests of a verbal and numerical type, but as only early education is through the medium of one or other of the Bantu languages, and all those requiring advanced testing for higher secondary or academic education, or for clerical appointments, would be familiar with English, such testing will present no difficulties and suitable tests are already being developed.

The African Adaptability Test also affords a better means of studying the intellectual potentialities of Africans and of the environmental factors that influence their development than has hitherto been available.

In the writer's opinion, the basic intellectual identity of whites and Africans has been neither proved nor disproved (Biesheuvel, 1952b). Control experiments of the orthodox type cannot hope to provide a conclusive answer because adequate control excludes the possibility of comparing representative samples (Biesheuvel, 1949). The practical value of such a comparison, assuming that it could successfully be made, would also be negligible, for it postulates an environment for African peoples which in reality can never be achieved, for geographic if for no other reasons. To the policy-maker in Africa—and policies with far-reaching consequences for millions of people are at present being evolved in Africa more intensively than anywhere else in the world—it should be of vital importance to know what increases in intellectual efficiency can be expected from the improvement of African nutrition, the eradication of tropical diseases, the spread of literacy, the availability of secondary and higher education, or changes in family circumstances and in parent-child relationships following on the adoption of Western cultural habits. Such information is highly relevant at a time when the foundations are being laid for new self-governing communities, and when it is still possible to give a particular slant to emerging institutions, to preserve or build upon worth-while aspects of indigenous cultures, and to plan the kind of society most likely to flourish in tropical Africa.

The African Adaptability Test, or at any rate the testing technique which it employs, can be applied anywhere in Africa because it is independent of language, and both primitive tribesmen and those who have received a primary education respond adequately to its method of administration. Primarily we are more concerned with the influence of environment on the power, than on the intellectual differentiation of the African mind, and it is to the former effects that the existing test, by virtue of its factor content, is likely to be more sensitive.

Opportunities have recently arisen to initiate large-scale studies of this kind. In Uganda, the British Medical Research Council, with the assistance of the Nuffield Foundation, has established a research unit to investigate the causes, effects and treatment of kwashiorkor, a deficiency disease which is common in most African territories. The plan of research provides for a study of the effects of kwashiorkor on mental efficiency, and the reversibility of these effects at different age levels under particular therapeutic conditions. It is hoped that the African Adaptability Test will be used in this research project.

An enquiry has also been received from the East African Malaria Unit, which is attempting the eradication of malaria in certain hyper-endemic areas. It wants to find out whether an increase in intellectual efficiency will occur in treated communities. As non-treated control groups are available, such an experiment, for which the Adaptability Test is particularly suitable, would be well worth while.

The use of the film technique of test administration presents some difficulties for field studies in remote areas; but these can be overcome by the use of a mobile testing laboratory. One such laboratory has already been constructed by the Government of Kenya, which is using the Adaptability Test in a number of vocational training programmes. Another mobile laboratory is under construction by the South African National Institute for Personnel Research, with the aid of a grant of £4,000 from the Carnegie Corporation. It will be equipped to use the film technique of test administration in more detailed studies of special abilities and the extent of their dependence on cultural circumstances. Equipment will also be carried for studies of psychomotor learning, in which Africans are believed to be inferior, though in some experiments that support this popular view, cultural factors have been insufficiently controlled.

Experimental work on the Adaptability Test is also being done at the University College of the Gold Coast, where the test is being tried out for the selection of various types of technical trainees. Arrangements have recently been made with two artisan training colleges in Tanganyika and the Sudan to apply the test for the selection of apprentices.

In every case, permission to use the test has been granted on condition that test scores, biographical and follow-up information on sample groups will be supplied to the N.I.P.R. This will make it possible, in due course, to standardise the test on a pan-African basis. By thus applying the same adaptability test in many parts of Africa, both to representative population samples under standard conditions, and to particular groups under experimental conditions in which one or other environmental influence is selected for study, our knowledge of the mental efficiency of Africans, and of the factors that determinate, is bound to be increased. When these data are supplemented by the more detailed studies of special abilities and the extent of their dependence on cultural circumstances that are in progress in the N.I.P.R., a picture may gradually emerge of the range and nature of individual differences among Africans under given environmental circumstances.

A point to be stressed, however, is that these studies have a bearing only on the intellectual components of behaviour. Under African conditions, these may be less important than such aspects of the personality as capacity for sustained effort, persistence of motives, and volitional control (Biesheuvel, 1952c). Whilst these attributes are predominantly culturally determined, the question must be put to what extent the African climate permits their full development. Nor can we exclude the possibility that, underlying these personality qualities, there are constitutional determinants and that by various genetic causes likely to have operated in Africa, the distribution of these determinants in African and European ethnic groups is different.

Research on the organisation of character in African populations, and on the constitutional determinants of personality is in progress (Biesheuvel, 1953, 1954; Mundy-Castle, 1953, 1953a, 1954). The N.I.P.R.'s mobile testing laboratory will be fitted with an electroencephalograph and other psychophysiological apparatus to pursue these studies further in the field. On the facts behind these difficult psychological questions, the shape of things to come in Africa will largely depend. It is important that we should find the answers, in order that guidance may be offered to the policy-makers before decisions are taken that may not be in the best interests of the peoples of Africa south of the Sahara.

THE STUDY OF OCCUPATIONAL APTITUDES IN THE WHITE POPULATION

Space will not permit more than a brief reference to the measurement of individual differences in the white population.

Sociological circumstances make it necessary that the ability potential in this section of the population should be known, and particularly that capacities for skilled work and for leadership should be fully utilised. The principal aims of test construction have therefore been to provide (1) a test of leadership ability; (2) selection tests for the skilled trades; (3) a general classification test, useful for manpower surveys and particularly applicable to the lower-grade occupations.

The first of these objectives has been achieved by adapting the group selection procedures of the British Civil Service Selection Boards to more general use (Arbous, 1953). By a happy chance, it was possible to base validation on follow-up studies of both rejected and accepted candidates for administrative employment, a validity coefficient of .68 ($n = 123$) being obtained, which in the case of one large industrial corporation gave 84% successes, when 4½% of applicants for appointment as administrative trainees were selected. The attainment of the second objective is in view, large numbers of artisan apprentices of all kinds having been tested in industry and public undertakings on a battery which included pencil-and-paper, psychomotor and personality tests. Validities are satisfactory, particularly when the pre-vocational educational record is taken into account. Psychomotor tests appear to add little or nothing to the prediction of trade test results, and the value of personality assessments is as yet uncertain, though promising results have been obtained by means of Pauli's Continuous Addition Test, which has the rare merit of being objective. A measure of staying power, obtained from this test, gave a correlation of $r = 60$ ($n = 30$) with unusually reliable progress results. Multiple correlation coefficients for test batteries with and without psychomotor tests, for various trades and a variety of criteria, range from .80 (30 lift technicians) to .47 (176 trade school pupils). Ways and means are being considered of turning the battery, which has been validated in piecemeal fashion against many different criteria, into a general selection and classification test for the skilled trades.

The attempt to construct an instrument for manpower surveys will start from a general classification test now being constructed for the military services. Its validities, calculated against training criteria for a wide range of Army duties, are high: highest multiple $r = .83$ (45 Armour Gunners); lowest multiple $r = .50$ (290 Infantry Riflemen); median $r_m = .59$ (120 Armour Loader Operators) and $r^m = .57$ (89 Artillery Drivers). By means of factorial studies of job requirements, it may be possible to avoid numerous *ad hoc* validations, in adapting this battery to civilian needs both as an instrument to grade adults in terms of five occupational levels, and to classify particularly those at the lowel levels for jobs involving predominantly manual work, clerical work or contacts with people. For this purpose, some personality assessment would have to be included to provide for jobs in which the social element predominates. It is a matter for further research whether a method of personality assessment can be found which is suitable for routine administration, less elaborate than the social interaction tests, but more valid than the many rating scales and projection tests now being traded in the psychological market places.

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A Search List for Use in Vocational Guidance

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Our aim (McKenzie, 1954) is to assess the basic personal qualities required in each of a number of occupations and then to group the occupations accordingly to form a 'Search List'. The idea is that the adviser, after similarly assessing these qualities in his 'client', turns to the appropriate area of his Search List, where he finds a sample of jobs which all need the general level of ability his client offers. This focusses the search and also provides specific 'job suggestions'. From these the adviser can pick out, in the light of his knowledge of the client's other characteristics and of local circumstances, those few jobs most worth further consideration. From our earlier discussion it appeared that three 'dimensions' most nearly met the suggested criteria for dimensions on which to base such a classification, namely, General Intelligence, General Level of Educational Attainments, and Background Support (*i.e.,* the amount of support available to a client, or needed by the job, in terms of general circumstances, stability of background, family attitudes, financial resources, and so on). Further, since at present each of these adds something important in vocationally advising a client, it was clear that all three must be considered, both in studying jobs and in assessing clients.

COLLATING AVAILABLE DATA

We have ignored for the moment possible variations in the scope and responsibilities of a given occupation in different firms or areas. Even so there are still so many different occupations that any classification must make full use of material already available, even though some of this has been collected for purposes other than vocational guidance. Methods, tests, and samples have thus varied, and the integration of the data for our purpose consequently involves some compromise. Thus units of measurement must be wide enough to tolerate differences of test or sample. They must be practicable too in assessing people actually in various jobs, as well as individual clients.

General Intelligence

The definition is briefly 'score on a test of general intelligence of known characteristics'. In grading scores the familiar scale was used: '1' the top 10 per cent. of the general population; '2' the next 20 per cent.; '3' the middle 40 per cent. (split into '3+' and '3−'); '4' the next 20 per cent.;

and '5' the lowest 10 per cent. The median score and, where possible, the upper and lower quartiles for each occupation were taken from each source, noting test, details of sample, etc. These scores were then put in terms of the five-point scale with regard to the general population. Thus on 1938 Progressive Matrices (20 minutes) the norms used were: '1' for scores of 47 and over; '2' scores of 42-46; '3+' scores of 38-41; '3−' scores of 34-37; '4' scores of 26-33; '5' scores of 25 and below. If the distribution of scores in an occupational sample is Q1 39.8, Median 44, Q3 48.2, these become Q1 3+, Median 2, Q3 1. For the immediate purpose of the Search List the *median* was taken as the single index.

Material used so far includes occupational scores on the 20 minute version of Raven's Progressive Matrices of wartime Royal Navy recruits (Vernon, 1949), in particular of the 17-19 year age group, and of wartime A.T.S. recruits of ages 20-24 (Lingwood, 1952). On N.I.I.P. Group Test No. 33 scores were available of training college students, graduates and non-graduates (Vernon, 1939; Babington Smith, 1940; Tozer and Larwood, 1953); of 800 arts and science undergraduates, and 50 medical graduates of Edinburgh University (unpublished); of various levels of engineering apprentices, trade apprentices, and semi-skilled workers, in the services, and unskilled workers in industry (Farmer and Chambers, 1936; Stanbridge, 1936); and of engineering and trade apprentices in industry (Holliday, 1940). Other scores on these tests came from unpublished work of the Applied Psychology Unit of Edinburgh University. On Cattell's Scale III there were occupational scores of 1,039 men and women (1934). Occupational scores were also used of 89,000 men on the U.S. Army General Classification Test, quoted by Super (1949); of 18,000 men on the U.S. Army Alpha Test (Fryer, 1922), and of 9,000 men of an American factory population on a test based on the Alpha Test (Pond, 1933).

Objections can be made to some of the data. Services samples may well be biassed through medical standards, 'reserved' occupations, etc.; thus the A.T.S. sample is biassed since women whose scores on Matrices were in the lowest 10 per cent. of the general population were not recruited. Samples varied too in age range, and the method of turning scores into grades can be criticized, not least for the assumption that the various tests used measure even approximately the same thing. Yet the scale used is a coarse one, so some of the inadequacies may be tolerated, and also details of test, sample, and actual scores are readily available on the job card. Also, although for some occupations scores came from both American and British sources and tests, they were surprisingly consistent; in any clash, weight was given to the British data, to the better sample, and to recency, in that order. Thus, several considerations were subordinated to the aim of obtaining guiding information on as many jobs as possible, and putting it in some common form as a source of positive job suggestions. In general this information refers to intelligence *found in*, rather than that *required for*, each job. The lower quartile, or even the lowest point of the range, might indicate the minimum required; the optimum for each job is usually not known.

Educational Attainments

At the moment this is defined as 'general educational status' rather than 'residual ability', a distinction made in the previous article. The simpler the scale the more chance there seemed to be of finding useful data over a large area of jobs, and the fact that the classification is primarily for use in advising school-leavers who have not yet taken further training helps to keep the scale simple. Sources include entry regulations for universities, professional bodies, trades, etc., as well as interviews with employers and personnel officers, and employees, while some published data (*e*.g., Lingwood, 1952) include a translatable educational standard.

Again, a five-point scale was used on the lines briefly indicated below.

1. Up to or likely to reach University entry standard in leaving certificate examinations, i.e., roughly, in General Certificate of Education, 2 advanced and 4 ordinary passes, or 3 advanced and 2 ordinary, or, in Scottish Senior Leaving Certificate, 4 higher passes, or 3 higher and 2 lower; or of Level 2 but eager to continue or widen his studies.
2. Up to, or likely to reach, 17 year leaving certificate *area,* but not up to 1 ; *e.g.,* is likely to make 1 or 2 highers, but not the whole group in S.L.C., or several passes at Ordinary level in G.C.E., or Level 1 but is not fond of school work ; or Level 3 with consistent progress and eager to continue studies, not necessarily in school.
3. A good average 15 year old leaver ; in Scotland, a Junior Secondary Certificate, in England, an encouraging school report; steady progress, but not likely to reach Level 2 ; etc.
4. Lower half of 15 year old area, including those who have fallen back a year in their progress ; etc.
5. The rest ; 2 or more years behindhand at 15 ; etc.

For several reasons these five grades are kept as general as possible. For instance, although official entry regulations are sometimes very specific, in fact their operation is not so rigid. Sometimes too there are several educational roads into a job ; certainly the range found in jobs is quite wide. Also where entry levels are not laid down, the level of people actually in the job has to be found and this may involve reconciling English and Scottish educational systems, or systems of different dates. More precise details are given on each job card, but more specific *classification* of them became rather complex, with little apparent gain. In general the rating for each job sums up the educational level found in the job, or stipulated for entry.

Background Support

Briefly this is 'the amount of support available to the client or needed by an entrant to the job in terms of general circumstances, attitudes of family and peers, financial resources, and stability of background'. Clearly there are several elements, but since they are often interdependent it was argued that Background Support can, for a start, be treated as unitary. Information came from sources similar to those used for Attainments, while selection projects, survey interviews, previous experiences of vocational guidance clients, and job description visits, can all be tapped. Again a five-point scale was used, and outlines of definitions are:

1. Background support for over 2 years of full-time training, including maintenance and university, or equivalent, fees (*i.e.,* up to something like £80 per annum), the family accepting the implications of such training; for example, a well-knit family, with some resources, which values 'professional' training and status; or a family less well-off but with helpful attitudes and relationships.
2. Support for 1 or 2 years of incomeless training as above; a family of average income, strongly motivated, willing to use any assistance available to do all it can to help the client, and with maximally helpful relationships and attitudes; or, on the other hand, of level 1 financially, but not very interested, or with psychological support so uncertain as to lower the client's effective level of functioning; and so on.
3. Support and encouragement as needed, for instance, for 5 years apprenticeship; 'money must come in, but some can be spent on tools, books, class fees, etc.'; the family with average income, a stable occupational pattern, a reasonable concern for the client's future, and attitudes favourable to evening classes and the like; or level 4 financially but strongly motivated.
4. Financially a long apprenticeship would weigh heavily; 'apprenticeship if he likes, but he'll have to look after himself and there's others coming on'; level 3 but unconvinced of the value of training, or cannot afford much delay in finding a suitable job.
5. Where the only concern with the client's job is, or has to be, how much money it will bring in and how soon; or the effectively broken or demoralized background offering minimal support to the client's prospects.

Again the grades are in general terms; they aim to be relative, because actual figures become out-of-date, and also vary in different areas, while trying to quote them might over-emphasize the financial element. The rating of a job indicates the Support needed as from the school-leaving age at which the job, or direct training for it, is entered. A difficulty may occur here; using the Search List the adviser of, for instance, an intelligent 15 year old client with attainments well above average but with Background Support rating only 3, will be led to consider, among others, jobs which involve staying at school to 17 or 18, but which then require no private expenditure on training, and so are rated 3 in the Search List. But for this client such jobs rate Background Support 2, since at his age they demand support for the extra years at school. These job suggestions, however, would still seem worth making. In any case, as before, details of training costs, and references to sources, are kept up-to-date in the Brief Job Descriptions consulted during discussion of job suggestions.

Though financial aids are available, they are not directly taken account of in these grades, partly because of local differences in allotting them, partly because the financial element is not the only one we have to consider.

Nor, of course, do these definitions imply that unfavourable attitudes or factors must simply be accepted. The first step, however, is to make a realistic appreciation of the client's immediate situation. Again, it may seem arbitrary to try to make a single rating, yet in practice this pressure often throws into relief gaps in one's information, or even reorients the whole approach to the client's problem.

A general point is that in all these dimensions the ratings show central tendency rather than the *range* found in people in the job, and this range may be considerable, stretching perhaps from the grade above to the grade below that in which the central tendency lies. Again, in some jobs the ratings more nearly reflect the actual people they were based on, if given as two figures instead of one (*e.g.*, 1/2), not so much showing that the theoretical central tendency would lie on the border, as suggesting the actual distribution. This is especially necessary in the Attainments and the Background Support ' dimensions ' ; even in the rating of Intelligence it avoids unrealistic arbitrariness, and indicates something of the range. Finally it must be stressed that these ratings, whether of job or client, are merely intermediate summaries of information which at a later stage has to be considered in detail, along with other information about both job and client.

THE SEARCH LIST

In this way ratings were built up for each job, the detailed data being added all the time to the Brief Job Descriptions. Thereafter jobs with identical patterns of ratings were put together, that is all those rated Intelligence 1, Attainments 1, Background Support 1, in one group; those jobs rated 1, 1, 1/2 in another; and so on. On examining the groups some useful points emerged. Just as these three dimensions, though all relevant in vocational guidance, may not correlate highly in individual clients, similarly when jobs were rated in our terms, it was found that seldom does a job have exactly the same rating on all three dimensions. Rarely, on the other hand, does the rating of one dimension vary by more than one grade from the ratings of the others, so that jobs with widely divergent ratings like Intelligence 5, Attainments 3, Background Support 1, have simply not been found. (The ratings give, of course, only the level *found* in each job, not the demonstrably 'required' level. Also, they indicate central tendencies only; in any job there may be found *individuals* with divergent ratings.) These dimensions are linked, too, in the sense that a slightly higher level of Intelligence in a client can balance up a slightly lower level of Background Support; good Background Support can help to compensate, within limits, for a lower level of Attainments; and so on.

It was clear then from the patterns of ratings actually found that jobs could be grouped into five main 'General Levels', still basing classification on three dimensions rather than any single one. General Level 1, for instance, lists jobs with ratings that centre around '1'; more precisely, it contains jobs with a rating of '1' on at least one dimension, the others going down as far as '2'. No job with any rating as low as '3' is included

TABLE I

PART OF G.L. TWO	GENERAL LEVEL THREE				PART OF G.L. FOUR
SUMMED RATING (8)	SUMMED RATING (9)	SUMMED RATING (10)		SUMMED RATING (11)	SUMMED RATING (12)
2 2 3/4 Admin. apprentice (RAF) Aircraft apprentice Civil Service (clerical officer) 2 2/3 3 Advertising Aero-engineering draughtsman Fever nurse Mechanical engineer (engineering app.) Mental nurse Nursing (general) Nursing in the colonies Sick children nursing Surveyor 2 3 3 Bank clerk Book-keeper Calculating machine operator Clerk, general Technical photographer 3 3 2 Radio officer (civil aviation) Radio officer (Merchant Navy)	2 3 3/4 Commercial traveller Warehouseman-clerk 2/3+ 3 3 Commercial photographer Comptometer operator Office machine operator Police Printer's reader Shorthand typist Tool fitter 3+ 2/3 3 Aero electrician Aero engine fitter Art, commercial Carpet designer 3+ 3 3 Addressograph op. Armature winder Book-binder (hand) Brass finisher Compositor Engineer officer (Merchant Navy) Fitter, engineering Litho artist Pattern maker Typist 3 3 3 Blockmaker Bookbinder (machine) Letterpress machineman Loco fitter Millwright Photo engraver Photo process camera operator	3+ 3 3/4 Civil Service (cler. asst.) 3+ 3 4 Army apprentice Bookseller asst. Despatch clerk RAF boy entrant Stock clerk Window display 3+ 3/4 3 Carpenter and Joiner Cinema proj. Dental mechanic Electrician 3 3/4 3 Cabinet maker Coachbody builder Dressmaker (fitter) Milling machinist Saw doctor Ship joiner Shop fitter Tailor, tailoress Turner, metal 3 4 3 Agricultural machinery mech. Baker Diesel mechanic French polisher Motor vehicle service mechanic Plumber Shipwright Undertaker	3– 3 3/4 Children's nursemaid Nursery nurse Postman 3– 3/4 3 Electrotyper Paper ruler Stereotyper Wood turner 3– 4 3 Asphalt spreader Banker mason Blacksmith Bricklayer Brickmaker Coachpainter Coachsmith Coachtrimmer Coppersmith Country blacksmith Fireplace maker Fixer mason Floor and wall tiler Hairdresser (ladies') Mattress maker Painter and decorator Panel beater Sawyer Sheet metal worker Ship plater Slater Tile maker Upholsterer (skilled) Welder Wood machinist	3+ 3/4 4 Cash desk cashier Grocer (asst.) 3 4 4 Art stenciller Baker's shop asst. Bus driver Butcher's shop asst. Capstan lathe setter Centre lathe operator (semi-skilled) Conductor, P.S.V. Crane driver Fireman, loco. Furniture shop asst. Railway engine cleaner Shoe repairer Tailor's cutter Women's and children's clothing shop assistant 3– 4 4 Alteration hand (dressmaking) Binder, hosiery Coal miner Electro-plater Gardener Hand sewer Lorry driver Metal machinist (semi-skilled) Milliner Sewing machinist Storekeeper (factory) 4 4 3 Brass moulder	3– 4 4/5 Carpenter's mate Laundry checker Motor driver's mate 3–/4 4 4 Boot and shoe machinist Capstan lathe operator Coil winder (small coils) Sawyer's tailsman 4 4 4 Acetylene cutter Assembler (factory) Cinema attendant Concrete worker Cook Dance hall attendant Docker Domestic service (private) Machine minder Plater's labourer Steel erector Textile worker Transformer assembly (small) Waiter Waitress Waterproof garment maker Wire weaver

A sample of the jobs in General Level 3, showing the construction of the Summed Rating columns; to give job ideas each column can be regarded as a single group of jobs. The number of reference points given is sufficient to make interpolation, even from incomplete data, feasible.

unless both the other ratings are '1'. Similarly General Level 2 lists jobs with ratings that centre around '2'; in it go jobs excluded from General Level 1, and which rate '2' or higher on at least one dimension, the others going down to '3'; no rating may be as low as '4' unless both the others are '2' or higher; and so on. A rule of thumb is that General Level 1 contains jobs of which the 'average' of the ratings is 1 or more but less than 2; General Level 2 contains those of which the 'average' rating is 2 or more but less than 3; etc.

The next question was how to lay out the groups of jobs within each General Level for greatest convenience. The sample page of the Search List in Table 1 shows the result of the straightforward convention of putting in a single column all the jobs whose ratings sum up to the same total. This gives three 'Summed Rating' columns in each General Level, except the fifth; *e.g.*, there is in General Level 3 a column of jobs all with a Summed Rating of 9, a Summed Rating column of 10, and one of 11. Within each column there are still slightly different patterns of ratings; these patterns are listed as headings down the column, first in order of the Intelligence rating, then within that in order of Attainments, finally in order of Background Support.

The position is now that several hundred jobs have each been rated on three dimensions, and put together in groups of identically rated jobs. These groups have been placed in five General Levels, within which the groups are arranged in columns by a stated convention. This convention, however, has an empirical basis. Inspection shows that the jobs in a General Level do turn out to require a similar level of abilities, and jobs in a Summed Rating column are even more similar in their demands, at least in terms of our definitions. The range in the whole of General Level 3, for example, is only from jobs rated Intelligence 2, Attainments 3, Background Support 4, to jobs correspondingly rated 4, 4, 3, while within the Summed Rating column 9 the range is from jobs rated 2, 3, 4, to jobs rated 3, 3, 3. In theory we might find in this column jobs rated so variously as 1, 3, 5, and 5, 3, 1 (they would still come under different headings in the column). In fact, however, we have not yet found any such jobs. Moreover, the ratings indicate central tendencies only; thus the jobs quoted as the extremes of Summed Rating column 9 are rated 2, 3, 4 and 3, 3, 3, but the Intelligence level found in the first, for example, has an interquartile range from 1 to 3+, and in the other from 2 to 3−, giving a considerable overlap. So the range of ratings in the groups of jobs within a Summed Rating column may be inside the range of abilities actually found in any single job. Similarly, although a client's abilities can compensate each other only within certain limits, the variations of abilities needed in the various jobs within each column are within those limits.

These points suggest that Summed Rating columns might be regarded, for the purpose of obtaining job suggestions, as single groups of jobs. A balance has to be struck between making the classification appear more rigid than the data justify, and on the other hand making it so flexible that the search for suggestions cannot be effectively focussed. The crux is the *range* of abilities found in every job. Some jobs might be placed in either or both of two Summed Rating columns, or even of two General Levels, if the range of abilities, rather than the central tendency, is emphasized. Indeed, once jobs have been placed in appropriate columns by using these ratings, to maintain the distinction between the groups in a column may very well 'blinker' the adviser by failing to stress the overlap of the ranges of abilities involved.

There is another cogent reason for not overemphasising this distinction. So far we have relied entirely on the 'dimensions' of Intelligence, Attainments, and Background Support. In the Summed Rating columns, however, we have reached the point where we have approximately equated jobs in terms of these dimensions. Here then seems to be the place for aptitudes, interests, traits, and other dimensions that could not validly differentiate over the entire field of occupations, to make their contributions. At this point the aim is to find out what characteristics differentiate people in different jobs within the same level—a much more limited objective. One implication is that we need not insist on the *same* basis of sub-classification in every General Level. Whereas in General Levels 1 and 2 'interests' might usefully differentiate jobs and people, in General Levels 4 and 5 other dimensions might better be used; this is consistent with Vernon's point (1953) that interests tests are less effective with average adults than at professional and business levels. The observation gives scope too for basing differentiation on very specific abilities such as manipulative skills, especially perhaps in General Level 4, but always within the limits of the Summed Rating column.

However, the question here is how useful is it to build into the Search List itself a sub-classification within Summed Rating columns based on any of these other dimensions. Some possible methods have been tried out. One is to write after the name of each job '*v:ed*' or '*k:m*', as suitable validation data accumulate. Another is to cut across the columns of the General Levels with a grouping by types of activity involved in the jobs. Jobs may be grouped within each column according to the school subject most relevant; what is important here is not that a job needs better than average Arithmetic, etc., but that it needs better Arithmetic than do other jobs *at the same level*. Another attempted grouping involved the satisfactions found in various jobs; thus jobs offer different degrees of security, various degrees of scope for planning one's own work, for 'completion' satisfactions, or for 'status' in various terms, while there seem to be important but different types of 'social' or 'contact with people' satisfactions according to the roles and relationships involved in the interaction. But different people may find different satisfactions in the same job (Cox, *et al.*, 1953), while the chances of obtaining certain satisfactions often depend on the supervisor, or the working group, rather than the work itself. Perhaps the most we can say is that a job does at least offer *scope* for such-and-such motivations. Similarly we can sometimes discern the main differentiating motivations of a client in the sense of 'what he is really after', even though they may be so individual as, for instance, 'whatever I do it must make me one up on my brother'.

Experience showed however that any formal sub-classification within columns based on one of these dimensions tended simply to pin the adviser down to a rather narrow range of ideas, while at the same time it did not in fact add much validated information, since we have already used the dimensions on which we have most occupational data. It seemed in fact that these other dimensions could be better integrated with the Search List approach if used on lines like those suggested below.

THE SEARCH LIST IN USE

At the moment then the Search List is in the form of five General Levels, each (except the fifth) broken up into Summed Rating columns. Each column is divided into groups of identically rated jobs, as shown in Table 1. In practice, owing to the overlap of abilities required in jobs in a particular column, each column may be usefully regarded as a single group, and the jobs listed in alphabetical order.

The adviser first assesses the Intelligence, Attainments, and Background Support of his client, and summarizes his data into ratings according to the suggested definitions and scales. Just as the ratings of a job were put together, so the client's ratings are treated to show his General Level and the Summed Rating column from which the adviser should start. This represents the upper end of the range of jobs open to the client; within limits all the jobs needing lower levels of abilities may also be considered. On turning to that General Level and the indicated column, the adviser has before him a list of jobs all requiring approximately the general level of abilities offered by the client. Now the adviser sums up his other information about the client, including his *v:ed* or *k:m* bias if data permit. Bearing this in mind, and also his knowledge of local employment conditions, he then scans the column of jobs, briefly considering each one. Usually three or four jobs stand out at once as distinct possibilities. For those few jobs thus highlighted out of hundreds the adviser now consults the relevant job descriptions to check in detail that they are suitable for the client; he checks too that each job is available in the district, or likely soon to be so. He then discusses each job with the client, using his own knowledge, the job description, and if necessary the further references quoted in it. Once the client's Intelligence, Attainments, and Background Support have been assessed, and his test bias established, we reach an area of such closely related aspects of his personality as interests, preferred school subjects, preferred satisfactions and range of effective substitutes, attitudes, frustration tolerance, and so on. It is these with which the adviser is particularly concerned in the discussion stage. An approach at this stage is for the adviser to draw out in general terms from his knowledge of the client the two or three 'job elements' to which he is most likely to respond. Thus for one client the adviser might look first, in the Summed Rating column, for a job involving 'high social status, a chance to use maths, working on his own', in that order; for another boy of the same level the most important job elements might be 'plenty of company, using machinery to make things, chances of showing physical prowess'. Similarly the job descriptions must include for each job the most often quoted satisfactions and dissatisfactions as well as something of the pressures and relationships in the work situation. Discussion of specific job ideas with the client elicits from the client very 'live' reactions and attitudes, so that even if none of the first job ideas turn out to be acceptable the adviser can refer again to the Search List, but with his client's needs and personality by that time much clearer in his mind. The process makes clear too what other test or interview data are needed to lead the client to a final choice. All the time the adviser has before him a large sample of jobs grouped in defined terms; he can easily look across from one column, or even a General Level, to another, the differences involved always being explicit.

This description of the use of the Search List is necessarily brief, but indicates clearly that it does not eliminate any of the adviser's skills, nor the need for adequate yet concise job descriptions; rather does it try to bring them to bear quickly and directly on the more individual aspects of client and job. It is designed to offer constructive and life-like suggestions (not solutions) and to do this in a way that keeps the adviser and client alert to the variety of jobs possible.

It may however be argued that the Search List technique moves too quickly to specific jobs rather than indicating a general orientation; thus if specific recommendations are made but eventually not implemented, the client may later choose a job only superficially in line with the advice given, through lack of a general directive. It is true that the adviser giving general vocational guidance, perhaps to clients still at school and so not concerned with finding actual posts, has a different task from that of the adviser who must place his clients in posts. In practice, however, each approaches his task from a mid-way position; the first must advise in realistic terms, giving thought to actual probabilities of engagement; the second must do his placing with an eye not only to immediate vacancies but also to those likely to arise in the near future, and to the probable distribution of abilities in the whole age group leaving school. Either may face a third task where the adviser has to deal with a more general re-adjustment of the client, perhaps also of parents, the vocational advice being only an element in the case; this is the task, for example, of the adviser linking psychiatric treatment or physical rehabilitation with re-employment. In all of these tasks the Search List approach seems to have something to offer.

First of all, some jobs do require early decision, sometimes well before leaving school, in order to decide for example which particular subject should be stressed, or to check that no disability such as colour blindness will eventually debar the client from a job he has set his heart on. Thus even educational guidance may quite early have a vocational orientation. Secondly, descriptions of actual jobs are of more help, especially to a young client, than descriptions of a 'type' of work. A general directive can still be given, but as a generalisation from specific jobs. Similarly in the 'clinical' guidance setting even adults gain more from discussion of specific jobs than of types of work, and one can be more realistic about chances of actual vacancies. Also, from the adviser's point of view, in making specific job suggestions he is compelled to weigh up his data about the client, and about jobs, very critically. And it is easier for him, and more realistic, to think of his client in terms of jobs he definitely can or cannot do, than to build up an 'absolute' picture of his abilities and then try to find a job which fits them.

Another point is that the reactions of the client, and of parents, as expressing attitudes, interests, ambitions, and the like, tend to be more explicitly, more realistically, and more quickly evoked by considering specific jobs, than by reference to a general type of occupation. This may fill vital gaps in the adviser's knowledge of the client, while if the client or parents have to readjust ideas and aspirations they can do so while still in the security of the 'advice' situation. Again, the Search List approach quickly shows up any inadequacies in the client's range of vocational information; since too the adviser has to discuss, however briefly, the jobs thrown up by the Search List, the process becomes mildly educative for the client. Finally, the client himself can take a direct part. By working through the relevant area of the Search List with the adviser, and discussing the job ideas, he realizes what factors have to be considered, sees where his attitudes have been based on inadequate information, and sees also that there is no single ideal job for him or anyone else, though a lucky and determined person might still make one for himself. Since discussion starts at his 'true' level he is made aware of his own potentialities and limitations, and encouraged to think reasonably and realistically about choosing a job, either now or in the future, without becoming dependent on the adviser. The Search List approach seems to give particularly useful opportunities for this non-directive approach to vocational advice.

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Aptitude Tests for Air Traffic Control Officers

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THE investigation described in this article was commenced several years ago. However, although the correlation then obtained between training course results and test scores suggested that the battery of tests would be of considerable value, it was thought desirable to delay publication until some conclusions based upon the actual professional performance of the subjects should be available. By late 1953 it had been possible to make a follow-up study of a reasonably large sample of personnel who had been tested upon entry to their training courses, and had subsequently served with the Commonwealth Department of Civil Aviation in the capacity of Air Traffic Controller, for periods varying up to two years or more. As the careers of the men progress, it will be possible to collect data even more relevant than that at present to hand. Nevertheless, one may now present results indicating the value of the tests used, in predicting not only proficiency in training courses, but also actual professsional efficiency in so far as the latter may be judged from the early confidential reports of senior departmental officers.

DUTIES OF THE AIR TRAFFIC CONTROL OFFICER

It must be pointed out that in Australia the range of duties of the Air Traffic Control Officer extends considerably beyond the actual direction of aerodrome traffic from a control tower. That, important as it is, is only one of three main aspects of control in the broader sense. One of the other two consists of supplying relevant information to airline pilots who wish to prepare flight plans. Such officers must also approve or suggest acceptable modifications of such flight plans when presented by the pilots before the flights commence. The third function of the Air Traffic Controller relates to the direction of aircraft in flight in the period when they are no longer under the direction of the control tower at the point of departure, and have not yet reached the zone controlled from the tower at their destination. This involves, amongst other things, checking continually the position of aircraft, ensuring that the periodic reports required from such aircraft have been given, and if necessary the institution of search and rescue procedure when doubt arises as to the position or safety of an aircraft. Needless to say, an Air Traffic Control Officer in any particular appointment is not required to fulfil all three functions simultaneously; but it is the general policy of the Department that officers should be experienced in and capable of all these duties, and transfers from one type of duty to another are made at intervals and in the normal course of promotion. It is therefore not desirable, even if it were practicable, to attempt to select personnel for any one field of duty rather than another.

It would appear unnecessary in an article of this length to attempt to describe details of the general control procedure as laid down by Departmental regulations. It may, however, be said quite simply that the most obviously necessary personal characteristic demanded by the work is the ability to divert attention rapidly and effectively from one task to another at the shortest notice, in accordance with a scale of priorities dictated by an intelligent judgment. This applies to every phase of the controller's work; he is continually required to absorb information coming piecemeal from a variety of sources and on a variety of subjects. He must inter-relate this information, when relation is possible, and must act repeatedly, accurately and intelligently against a constantly (and often rapidly) changing background. Sound judgment, memory, attention to detail and, above all, the capacity to remain calm and unruffled in the face of situations demanding the division of attention between two or more lines of action that must be pursued simultaneously as far as it is physically possible to do so—these are cardinal attributes of the efficient controller. The basis for the effective use of these attributes is a wide and detailed range of technical knowledge of matters related to practical flying, aircraft performance, navigation and flight regulations. It may be safely assumed that such a store of knowledge, organised for ready use, cannot be obtained without the possession of a high level of verbal, spatial and numerical intelligence. This fully justifies the use of the title 'officer', and presupposes a superior intellectual standard as a basic requirement.

SELECTION OF A TEST BATTERY

With the intention of covering the factors mentioned above, a considerable number of tests were administered to members of one of the training courses being conducted in Melbourne. Though most of these tests were found to give some positive correlation with instructors' ratings, it was found that, in terms of multiple correlation, there was no justification for retaining more than five. Of these, three were tests which had been widely used in the Royal Australian Air Force (RAAF) during the war; the other two had been developed for this particular purpose.

The RAAF tests were as follows:

Test S:

This is a test of spatial aptitude in which a positive completion method was used for recording the solution of problems, rather than selection by multiple choice. The test is generally similar in principle, though not in detail, to the Test K of the British wartime GVK series.

Test M:

This is a measure of aptitude for numerical calculation. It traces its ancestry back through several generations to the arithmetic and series sections of the original Army Alpha. In its present form, however, simple arithmetical problems and number series are alternated.

Test T:

This is of the 'omnibus' type, though the term is not strictly accurate as the items included are essentially spatial, mechanical or numerical in character. It was prepared during the war by condensing the more valid items of three tests used earlier for the selection of technical trainees, and proved very effective for that purpose. Answers to some of the items are by multiple choice, others by positive completion; but all have been carefully designed to avoid ambiguity and ensure simplicity of marking.

Two newly prepared tests proved useful to supplement those mentioned above. They were:

Test K:

This was designed essentially as a discriminating memory test. In construction it is very short and simple, but nevertheless has proved quite effective. It consists of two sets of monosyllabic words, ten in each set. These are read to the subject clearly at an even rate, without accentuation and with a clearly indicated break between the two sets. The subject is then required to write down in separate columns those of the words he can remember from each of the lists. One point is credited for each word correctly remembered and placed in the right list. One point is subtracted for each word placed in the wrong list, or for the recording of any word not included in either of the lists read.

Test M.R.I. (Map Reading with Interruptions):

The aim of this test is to assess capacity to carry out mental tasks of a moderate degree of difficulty under the stress of frequent distractions. It was also considered desirable to select mental tasks of a type bearing a close relationship to operations actually performed by personnel in the course of their professional duties. For this purpose map-reading was chosen as affording a good basis for a test situation. In the final form in which it has been used the test consists of the following:

Each candidate is presented with a copy of a map of an imaginary locality, showing towns, villages, rivers, coastal features, etc., with a grid for reference and a clearly marked scale. With the map is a sheet containing a number of questions relating to the map. These are graded in order of difficulty, and start with simple requests to locate particular places and indicate their position in terms of grid squares. Then follow more difficult items involving calculation of distances by reference to the scale. (Each subject is provided with a pair of simple dividers to facilitate scale measurements.) The sheets containing the questions and spaces for answers also contain a column marked 'memoranda'. Candidates are instructed in the first instance that although they are required to work as many examples as possible in the time allowed, they must enter immediately in the 'memoranda' column all messages 'received' during the period of the test. Failure to record these messages will, they are told, result in heavy penalties. The purpose of this threat is to ensure that all candidates will in fact record the messages *accurately* and therefore enable the score of the test to be made in simple terms of output of correct answers to the map-reading questions. This result has in fact been easily achieved, no instance having come to the notice of the writer in which memoranda have been incorrectly noted.

The actual 'messages' are twenty in number and are given orally by the examiners to a strict time schedule of irregular intervals throughout the thirty-five minutes allowed for the test as a whole. The content of the messages is varied but may be gauged from the following examples, which are similar to, but not actually the same as, some used in the test:

"Please note the following serial numbers: 2643 and 5728."

"Please note that visibility at Mascot has been reduced to one mile."

"Please note that Flight 431 from Essendon has been cancelled."

Each message is read twice over so that candidates can check their notes immediately. This helps to ensure the accuracy required in this matter, without diminishing the distracting effect as far as the map-reading is concerned.

RESULTS IN RELATION TO SUCCESS IN TRAINING COURSES

The battery outlined above was administered to the personnel of nine successive training courses, each consisting of about ten men. Up to that stage the tests were not actually used for selection purposes, so in that respect the correlation coefficients obtained cannot be subjected to statistical extension. However, the men had been carefully selected by other means (interview, technical experience, etc.) and it may thus be safely assumed that in applying the battery as a preliminary measure in selecting from a normal range of applicants, the usefulness of the tests would exceed rather than fall short of the value suggested by the observed coefficients.

In calculating these coefficients the criterion used was the final rank order of the men based on their examination results at the completion of their course. In view of the small numbers in each course the Spearman rank difference technique was employed. The results obtained are indicated in Table 1. The 'total' test score was arrived at from the standard scores in each test, without giving special weight to any test or tests. The coefficients relating to these are therefore not the result of multiple correlation in the strict sense. For the present practical purposes, however, they are regarded as more generally informative.

It will be seen from Table 1 that out of 43 test-administrations only three coefficients are negative, and only five others are below .2. Of the remainder 29 exceed .4, 20 exceed .5, and 12 exceed .6.

TABLE I: CORRELATION OF TESTS WITH CRITERION OF CLASS PROFICIENCY IN TRAINING COURSES.

COURSE	NO. IN COURSE	S	M	K	T	MR	TOTAL	APPROX. LEVEL OF SIGNIFICANCE OF TOTAL
A	11	·70	·68	·72	·68	·42	·81	·001
B	11	·46	·81	·52	·65	·52	·95	·001
C	11	·33	·31	·53	·42	·40	·69	·01
D	12	·01	·54	·40	·60	·42	·54	·05
E	9	·42	·57	·54	·68	·60	·78	·01
F	11	·28	—·18	·00	Omitted	·43	·12	—
G	10	·15	·60	·37	·23	·52	·39	—
H	8	·09	·29	—·49	Omitted	·80	·32	—
J	10	·92	·21	—·04	·48	·53	·66	·01
Mean values for 9 courses and approx. levels of Significance	Total No. of cases =93	·37	·43	·28	·54	·52	·58	<·001

It will be noted that the figures for Tests T and MR are high throughout. Test T was not administered to two courses (F and H) for reasons quite unconnected with the purpose of this study. It is indeed unfortunate that this omission had to be made, as the positive consistency of this test reasonably suggests that the totals in these cases (the lowest two in the list) have probably suffered from this omission.

The fact that no coefficient lower than .40 was obtained with test MR indicated the value of this as a consistently valid index, and confirms the *a priori* supposition that resistance to distraction is a vital factor in suitability for work of this kind.

Although there are some instances of low or negative correlations with tests S, M and K, their general performance over the whole group appears to justify their continued use in a selection battery. (The figures obtained from the 'follow-up' study described below would appear further to justify this conclusion.)

RESULTS IN RELATION TO EFFICIENCY IN THE PERFORMANCE OF DUTIES.

To validate test results against success in examinations at the conclusion of training courses is frequently the only procedure possible, and the psychologist can hardly be blamed if the training courses do not adequately provide a basis for professional proficiency. Nevertheless, it is the prediction of professional success, and not merely of training course results, which is the real object of industrial selection. Consequently, the argument for adopting a test battery as a standard item in selection procedure is considerably strengthened when it can be shown that positive correlation at a significant level exists in both cases—*i.e.*, between tests and course results, and also between tests and success in the actual job.

It was therefore decided to make some attempt at a 'follow-up' study as soon as practicable, and the results of this are given in this section. The criterion used in this case is based upon reports on approximately 70 controllers. These reports were made by the officers of the Department of Civil Aviation responsible for supervising the work of these men, and it was freely admitted by these officers that their own certainty about the opinions expressed varied considerably from case to case. To assist the writer in the preparation of a criterion, therefore, the brief comments on each man were annotated to indicate whether the comment might be regarded as a 'fact' (*i.e.*, likely to be true beyond reasonable doubt) or opinion (*i.e.*, the tentative view of at least one person who had been able critically to observe the work of the man concerned).

From the list of comments supplied it was found possible to subdivide the subjects of the reports into five categories, representing decreasing degrees of effectiveness as officers of the Department. This subdivision certainly called for the exercise of personal opinion on the part of the writer, who therefore feels it is most desirable to record here anonymously the actual text of the comments upon which the separation was made. The reader may therefore judge for himself the consistency of the criterion employed and so assess the value of the statistical results obtained from the comparison.

When considering the comments on each man, it must be clearly appreciated that these were made by high-level supervisors whose standard of reference is perfection. In publishing verbatim the remarks of these supervisors (and a verbatim report is, of course, technically the only relevant one for the purpose of this paper), one should bear in mind that weakness indicated is likely to be relative rather than absolute. All of the men must reach a certain minimum degree of proficiency before being posted to an airport or control station, and such comments as 'Poor controller—no future' and 'Nearly hopeless' may fairly be taken as uncomplimentary exaggerations. Moreover, they are made with reference to promotion to higher levels of responsibility, and it would be quite unfair to the Department to interpret these descriptions as implying that a low absolute standard of efficiency is being tolerated in this important work. In any case, the fact that the Department has initiated research into selection methods is an index of the stress placed by its officers on efficient Air Traffic Control; and the excellent safety record of Australian airways serves to underline this point.

Here then are the reports as grouped by the writer:

GROUP A: (Best Group)

Subject No.

A1: Has made good controller (fact)

A2: Very good (fact)
A3: Has been promoted to Grade 4 from Grade 1, very good and efficient, especially as supervisor (fact)
A4: Very good controller—has been promoted to Grade 2 (fact)
A5: Good controller (fact)
A6: Has proved very successful. Promoted to Grade 4 from Grade 1
A7: Very good controller. Promoted to Grade 2 (fact)
A8: Very good (fact). One of the best (opinion)
A9: Very good (fact)
A10: Good, especially as supervisor (fact)
A11: Very good (fact)
A12: Good controller (fact)
A13: Very good—now an instructor
A14: Has distinct ability in job (fact)
A15: Good controller on the job (fact)
A16: Very good controller (fact)
A17: Very efficient controller and supervisor (fact)
A18: Very efficient lower grade controller (fact)
A19: Very good on job (fact)
A20: Very good controller (fact)
A21: Excellent controller (fact)
A22: Good on job (fact)
A23: Very able controller (fact)
A24: Very able controller (fact)
A25: Very efficient (fact), but this may be due to long experience in job (opinion)

GROUP B:

Subject No.
B1: Good but impetuous
B2: Very capable, but suffers on personality side (opinion)
B3: Good controller in certain positions (fact)
B4: Very good controller (opinion)
B5: Good (fact). Spoilt by some personality trouble (opinion)
B6: Above average controller. Promoted to Grade 2 (fact)
B7: Good controller but unfortunate manner (fact)
B8: Very good but impetuous (fact)
B9: Now acting as Grade 4—from Grade 2 (fact). Good controller in some positions only (opinion)
B10: Good controller with a good future (opinion)
B11: Appears to be efficient (opinion)
B12: Efficient but unstable (fact)
B13: Good but not outstanding (fact)

Group C:

Subject No.
C1: Considered satisfactory. Only handicap is carelessness (fact)
C2: Satisfactory but inclined to careless work (fact)
C3: Took long while to come good. Now seems satisfactory (opinion)
C4: Moderate ability only (fact). Is over-keen and conscientious (opinion)
C5: Good average controller (fact)
C6: Good average controller (fact)
C7: Suffers from personality defects (opinion)
C8: Moderate only (fact). Appears to have no great future (opinion)
C9: Has shown up best as supervisor. Not so good as actual controller (fact)
C10: Could be good if he tried (opinion)
C11: Copes, but nothing out of the box (opinion)
C12: Personality troubles mar his work (opinion)
C13: Just average or a bit below. Passed over for promotion in favour of junior officer (fact)
C14: Average controller (fact)
C15: Average (fact). Does not like work (opinion)
C16: No wonder controller but quite successful (fact)
C17: Not very good. Hard to separate his work from his family (opinion)
C18: Just average (opinion)
C19: After ten years' experience just copes (fact)
C20: Manages job quite satisfactorily (fact)
C21: Manages all right but more interested in outside affairs (opinion)
C22: Just an average controller despite long experience
C23: Just average as controller—poor supervisor (fact)
C24: Good in tower work only where has had long experience (fact)
C25: Average controller (opinion)
C26: Not very good but can cope with most situations (fact)
C27: Average controller only (fact)
C28: Average-plus in job (fact). Perhaps due to great keenness (opinion)
C29: Just average (fact)
C30: Average (opinion)
C31: Average to average-plus (fact)

Group D:

Subject No.
D1: Has been placed in position requiring minimum of ability
D2: Not very satisfactory controller (opinion)

D3: Below average (fact). Appears to have no real potential (opinion)
D4: Just copes (fact)
D5: Just makes the grade (fact)
D6: Just makes the grade (opinion)
D7: Just passes (fact)
D8: Just manages (opinion)
D9: Not very good (fact). Don't think any improvement can be expected (opinion)

GROUP E: (Worst Group)

Subject No.
E1: Poor controller (fact). No future (opinion)
E2: Most unsatisfactory controller (fact)
E3: Nearly hopeless (fact)
E4: Very poor controller. Appears to be mistake in selection (fact)
E5: Poor controller (fact)
E6: Very poor controller (fact).
E7: Poor controller with no future (fact)
E8: Very poor (fact). No future (opinion)

Table 2 sets out the correlation coefficients obtained when the test scores were compared with the five-point criterion just described. (The product-moment method of calculation was employed.)

TABLE 2: CORRELATION BETWEEN TESTS AND PROFESSIONAL EFFICIENCY IN THE ACTUAL WORK OF AIR TRAFFIC CONTROL

TEST	CORRELATION COEFFICIENT	LEVEL OF SIGNIFICANCE
S	+·21	·05
M	+·29	·01
K	+·34	·001
T	+·32	·01
MR	+·23	between ·05 and ·02
TOTAL	+·45	<·001

Although these coefficients are not as high as one might wish, the high levels of significance suggest beyond doubt the positive nature of the contribution of the tests in the prediction of success. The use of this test battery would therefore appear to be fully justified, and one awaits with interest a new crop of reports made after a longer period of service, and hence likely to enable an even better criterion to be devised.

In conclusion the writer would like to express his appreciation of the help given to him by his colleagues on the University Staff and to officers of the Department of Civil Aviation, without whose co-operation the study could not have been satisfactorily carried out.

A Psychological and Statistical Study of Speed and Power as Variables of Human Ability

By OLGIERD POREBSKI

This paper is based on part of a thesis approved for the degree of M.A. in the University of London (March, 1952). The research was conducted in the Psychological Department of Birkbeck College under the supervision of Professor C. A. Mace.

INTRODUCTION

EVER since Spearman (1927) made his very important statement that the almost unanimous view that some persons are on the whole unable to think quickly and yet are quite able to think clearly would seem to be a most grave error, the concepts of speed and accuracy (or power) have been regarded as synonymous. This view has influenced considerably modern methods of intelligence testing. It made it unnecessary to distinguish between speed and quality of thinking on the assumption that these two characteristics correlate almost perfectly. The validity of this assumption is, however, questionable.

The experiments of Spearman and other subsequent studies which claimed a very high correlation between speed and quality were conducted by means of simple tests scored first on speed and secondly on accuracy without time limit. They cannot be accepted as sufficient proof for the lack of distinction between the speed and quality aspects of thinking. It can be doubted whether an accuracy score on a simple test is adequate to measure the quality of thinking. The latter undoubtedly implies accuracy, but it also implies much more emphatically a certain level of ability. The level of ability (altitude), however, cannot be determined by means of a simple test whatever the method of scoring. If the level of difficulty or complexity of problems the mind is capable of dealing with is the essential element in determining the quality of thinking, then it is illogical to make any inferences as to the distinction between the dimension of speed and the dimension of quality, when these two dimensions are both evaluated by means of the same test. In such a case a common element due to the same level of ability is by definition implied in speed and quality scores.

Now, although the identity of speed and power has been accepted by many psychologists, it has never been recognised by the commonsense view. One needs only to step out of the professional circle to learn that the popular view is still in favour of distinguishing between those who can think quickly and those who can think well.

The main purpose of the present research has been to investigate the commonsense view. At the outset, an attempt was made to clarify points of definition and experimental design. Thus the term quality or power was defined by the level (altitude) of thinking, as the ability to deal with complex relations (and not as the degree of accuracy on a certain low or arbitrary level). The quality of thinking defined in this way was denoted by the term Power. The speed of thinking was denoted by the term Speed. It was necessary then to devise the experimental design in which the two characteristics Speed and Power could be measured in isolation. The influence of Power had to be eliminated, as far as possible, from Speed scores and the influence of Speed from Power scores. It logically followed that the battery of tests had to comprise two sections. The first, the Speed section, had to consist of various tests of low and uniform difficulty. The second, the Power section, on the other hand, had to consist of various untimed tests of progressive difficulty.

If the ability to think quickly is indistinguishable from the ability to think well, then it should be possible to explain the inter-test correlations within the two sections by the same general factor. If, on the other hand, Speed and Power are distinct they should give rise to two distinct factors. In such a case the ability to educe relations and correlates could be accepted as having the two distinct dimensions. The first hypothesis was then formulated as follows: " Speed and Power are distinct factors of ability ".

Another purpose of the research has been to discover whether the factors of Speed and Power, if present in the process of educing relations and correlates, are the main factors or dimensions of this process. Were these two dimensions more fundamental than any alternative dimensions? As the crucial criterion we took the amount of variance explained by Speed and Power on the one hand, and by an alternative set of factors on the other. The most natural alternative appeared to be suggested by certain popular factors, such as Verbal, Spatial and Numerical. If the latter constituted the fundamental dimensions of ability then the degree of relationship between all the Verbal tests, or all the Spatial tests, or all the Numerical tests should be higher than between the Speed tests or between the Power tests, with different media of expression.

In such a crucial situation the more essential of the two alternative criteria of classification of ability could be brought forward. The distinction between the classes of the first criterion, in spite of the similarities with respect to the second criterion, could be compared with the distinction between the classes of the second criterion, in spite of the similarities with respect to the first criterion. It was our argument that the classification according to Speed and Power was more fundamental, consequently the second hypothesis was formulated as follows: " Speed and Power are the fundamental factors of ability ".

DESCRIPTION OF TESTS

To test the hypotheses a battery of nine tests was constructed. There were six Speed tests and three Power tests. The Speed (S) section had two Verbal, two Spatial and two Numerical tests, while the Power (P) section had one Verbal, one Spatial and one Numerical test.

Experimental test S1

The test consisted of twenty-five easy items of approximately equal difficulty. These items were of the common 'verbal analogies' type. They were designed to test the ability to find the relation between two words and on the basis of the inference educe the correlate of the third word. Two minutes were allowed for the completion of the test.

Experimental test S2

The test consisted of twenty-five easy items of approximately equal difficulty. In each item there were five words, four of them belonging to a certain class, the fifth being a distinct one. The object of the test was to measure the subject's ability to discover the relationship between four words and indicate the word to which the relation did not apply. One minute and thirty seconds were allowed.

Experimental test S3

Similar mental operations were called upon in this test as in S1, only instead of words drawings were used. The subject did not need to supply his own drawings but had a choice of five; one had to be selected as a suitable correlate. There were twenty-five easy items of approximately equal difficulty. The time allowed was two minutes.

Experimental test S4

A similar test to S2 was used, only words were replaced by drawings. There were twenty-five easy items of approximately equal difficulty. The time allowed was two and a half minutes.

Experimental test S5

This was a simple arithmetic test involving addition, subtraction, multiplication and division. This was not, perhaps, strictly a test of ability, for no relations or correlates had to be educed. There were altogether twenty-five items and the time allowed was four minutes.

Experimental test S6

This was a numerical test in which relations between a series of numbers had to be discovered and the next number conforming to this series had to be produced. There were twenty-five items. The time allowed was three minutes.

The above six Speed tests were administered as group tests in the order S1 to S6. The interval between the tests was only long enough to allow the instructions to be read.

The three Power tests [see Appendix] were given individually to be taken home and returned a week later. In the case where the testee desired to spend more time on the tests, another week was allowed. In this way the influence of time was practically eliminated, and also, a temporary indisposition was not allowed to play an undue part. The subject was provided with an ample opportunity of making several attempts at the solution of the problems; he could choose his own rate of work, his own best time and his own place and conditions.

Experimental test P1

This test had two problems. The first one, slightly easier, consisted of several processes of education of relations and correlates to be integrated into one solution; all the data had to be included. The second problem was perhaps more difficult because it involved the rejection of some irrelevant data and also because the relations involved were slightly deeper and more complex. Both were problems of verbal reasoning.

Experimental test P2

This was a test of reasoning in a spatial medium. It had three parts, each consisting of finding a two-dimensional relationship between drawings with a view to completing the right hand bottom square which was left blank. The first two parts were not unlike the type of items used in Progressive Matrices. They were relatively easy, the second being more difficult than the first. The third was extremely difficult, for, in addition to the first order relations used in the first two parts, it had a complicated principle not easy to detect.

Experimental test P3

This was a test of numerical reasoning, comprising three parts, of progressive difficulty. This difficulty, as in the spatial tests, was increased by means of the increased number and depth of relations involved. In this test the object was to discover a two-dimensional relationship between the numbers and, on the basis of inference, write the suitable number in the blank square. As in part three of the spatial test (P2), there were two possibilities of reaching the solution, either by a laborious logical analysis or by "insight".

SAMPLING

The sample selected for our study consisted of twenty-eight staff members of the National Institute of Industrial Psychology, and twenty-two first-year Psychology honours students from Birkbeck College, University of London.

Our sample was undoubtedly selective for it was limited to men and women of a high intellectual standard. With respect to general ability the variability of this group was obviously shrunken as compared with that of the general population. The correlation values were therefore expected to be largely underestimated and the absolute quantitative values of the factor loadings unreliable. Nevertheless, the relative values of the correlations could be assumed not to be seriously altered. Since our purpose was not to determine the strict values of factor loadings for each test, but to study the relative variance of Speed and Power as compared with that of Verbal, Spatial and Numerical dimensions, our results, in spite of the selectiveness of the sample, could be generalised.

SYSTEM OF SCORING

All the Speed tests were scored in the usual fashion, one point being given for each item answered correctly. No penalty was introduced for wrong answers and no correction for guessing was calculated or applied for those tests which involved a choice answer instead of a creative one.

The system of scoring the Power tests was originally based on the level of difficulty. With such tests used for the first time, the level of difficulty could only be assessed on *a priori* grounds. Thus it was felt that, instead of using original scores, it would be better to group the answers into three classes so that the top class comprised complete solutions, the medium class partial solutions, and the bottom class no solutions or unsatisfactory solutions.

STUDY OF CORRELATIONS

All the scores were represented in the contingency or correlation tables and the corresponding coefficients were calculated for all the variables. Since the value of a contingency coefficient can reach but a certain value when the classification is into three classes, all the contingency coefficients were adjusted so that they could be compared with the product moment coefficients of correlation.

These are presented in Table 1:

TABLE 1: CORRELATIONS OF SPEED AND POWER TESTS

	S1	S2	S3	S4	S5	S6	P1	P2	P3
S1 ...		.364	.455	.243	.382	.694	.595	.246	.257
S2 ...			.615	.320	.303	.348	.046	.343	.136
S3 ...				.485	.177	.504	.363	.322	.261
S4 ...					–.141	.224	.011	.260	.170
S5 ...						.187	.296	.178	.164
S6 ...							.582	.382	.295
P1 ...								.588	.568
P2 ...									.613
P3 ...									

From the correlations so obtained it was possible to study which criterion of classification—Speed and Power, or Verbal, Numerical and Spatial—tended to produce the clusters of high correlations and thus indicated the presence of factors. If the classification according to the material was more fundamental, then the degree of relationship among the Verbal (Speed and Power), or among the Numerical, or among the Spatial tests, should be higher than among the Speed tests with different media of expression, or among the Power tests with different media of expression.

The average correlations calculated from Table 1 were as follows:

·590 among Power tests with different media of expression.
·374 among Speed tests with different media of expression.
·320 among Verbal tests (Speed and Power).
·291 among Spatial tests (Speed and Power).
·229 among Numerical tests (Speed and Power).

In calculating the average correlation among the Speed tests the three correlations (S1 : S2, S3 : S4, and S5 : S6) were excluded for they had the same medium of expression. Similarly when calculating the average correlation among the Verbal tests, the correlation S1 : S2 was excluded on the grounds that both these tests measured Speed. For the same reason the correlation S3 : S4 was excluded from the calculation of the average among the Spatial tests, and the correlation S5 : S6 from the calculation of the average among the Numerical tests. This procedure secured as far as possible the determination of the value of correlation due to one criterion only.

If specific abilities constitute the most fundamental dimensions of ability, then the average inter-correlation between tests involving the same specific ought to be higher than the average correlation between any other group of tests involving a different specific. This, however, is not the case.

The inter-correlation of the Power tests or of the Speed tests, though involving different media of expression, is higher than the inter-correlation of tests having the same medium of expression, but coming from different sections of the battery (*i.e.*, Speed and Power).

It appears that the classification according to Speed and Power is more fundamental since it accounts for the larger proportion of independent variance. Within this criterion the presence of the Power factor can be more plausibly assumed than the presence of the Speed factor. The average correlation of Power tests is definitely larger than that of Verbal, Spatial and Numerical tests.

FACTOR ANALYSIS

The factor analysis of the correlations by the centroid method resulted in the centroid factors presented on the left hand side of the table which follows:

TABLE 2: CENTROID AND ROTATED FACTOR LOADINGS

CENTROID FACTOR LOADINGS	I	II	*ROTATED FACTOR LOADINGS	POWER G	SPEED g
S1 ...	.7299	.1491	S1	.4794	.5703
S2 ...	.5742	.3559	S2	.2289	.6356
S3 ...	.7055	.3719	S3	.3219	.7297
S4 ...	.3820	.3793	S4	.0638	.5352
S5 ...	.3582	–.1565	S5	.3779	.0999
S6 ...	.7261	.1402	S6	.4819	.5609
P1 ...	.6768	–.4373	P1	.8020	.0777
P2 ...	.6585	–.3752	P2	.7491	.1149
P3 ...	.5716	–.4530	P3	.7293	.0003

*Angle of Rotation 38° 24′.

When these factor loadings were rotated so as to make all the loadings positive, the new factor vectors represented the directions of Speed and Power. The only exception was the position of Arithmetic (S5). It was originally classed with the Speed tests yet in the analysis it appeared on the Power side with a very small loading on Speed. This result could, however, be explained by the fact that the scores on Arithmetic did not depend so much on actual speed of performance as on accuracy. Arithmetic had one characteristic in common with the Power tests, namely, that it involved a multi-stage process which had to be accurate in its entirety. All the remaining Speed tests, on the other hand, were such that the solution could be provided immediately in one stage. Another reason for the unexpected position of Arithmetic was the fact that it was not really a test of ability in the sense in which the other tests were. It was rather a test of proficiency in a specific operation.

Although Speed and Power could be represented by two orthogonal factors and thus could be regarded as two dimensions of ability, it was still necessary to demonstrate that these two dimensions were fundamental. In statistical language, we had to demonstrate that the factors of Speed and Power explained a greater portion of variance than the alternative factors, Verbal, Spatial and Numerical.

Speed and Power emerged as the first two, therefore the most important two, bi-polar factors. No amount of rotation of axes could change either of the first two factors into a Verbal, Spatial or Numerical direction. These specific factors, if present at all, might appear only as further and therefore less important factors.

To find out whether any of these specific types of material, Verbal, Spatial or Numerical, would appear as a further factor, the third centroid factor was extracted from the data. This factor had small loadings of doubtful significance. It had no psychological meaning even when various ways of rotation were tried out. In no position was there any indication that the direction could be represented by either Verbal, Spatial or Numerical ability. For our data, the factors of Speed and Power were found to be more fundamental than the factors, Verbal, Spatial or Numerical; in fact, they were the only meaningful factors.

RESULTS

Referring back to our original hypotheses, it is evident that ability, which is mainly expressed by the process of finding relations, can be measured along the two dimensions, Speed and Power. This is verified by the correlation analysis and by the fact that the factors of Speed and Power can be extracted from the data. In this way the first hypothesis is verified. The second hypothesis, which states that Speed and Power are the fundamental dimensions of ability, cannot be conclusively proved unless all other alternative ways of classification are tested for importance, in a crucial experimental situation. In our case we have selected the most popular criterion of classification according to the material and the most popular classes, Verbal, Spatial and Numerical. In comparison with these, the classification into Speed and Power appeared to be undoubtedly more fundamental. This was so strongly pronounced that the factors Verbal, Spatial and Numerical were completely suppressed and did not give any significant values at all.

CRITICISM OF THE EXPERIMENT

When the results of this research were reported during the XIIIth International Congress of Psychology in Stockholm in 1951, they were received with both positive and negative criticism. Leaving on one side the positive comments, it may be useful to summarize the negative criticism and the replies that were made.

There were altogether four negative comments: (1) That the distinction between Speed and Power means really the distinction between Speed and Accuracy. The latter, however, have often been shown to be very highly correlated. This has made it unnecessary to distinguish between these two characteristics. (2) That Power as used in this research is not entirely cognitive, but depends to a great extent on conation. (3) That Speed and Power factors were obtained from the analysis because the battery of tests was so arranged that one section contained Speed tests while the other section contained Power tests. In fact, the factors represented only what was originally assumed. (4) That the sample on which the data was based, by virtue of the fact that it was limited only to a highly intellectual group, gave preference to the appearance of Speed and Power factors rather than Verbal, Spatial or Numerical. Even if this was not the case, the results cannot be regarded as conclusive unless they are based on a representative sample of the population.

(1) can be answered by pointing out that a high correlation between Speed and Accuracy is by no means an established fact. Even if Speed and Accuracy were shown to be related very closely, this would not apply in the same way to Speed and Power. Although many people have used the word Power to signify Accuracy, in our sense Power does not mean Accuracy, but the Level (Altitude) of ability.

On (2), it must be agreed that Power is not entirely cognitive, but that it depends, in the causal sense, on conation. However, it must be also agreed that Speed depends on conation as well. Cognition serves conation and is related so intimately to it that to discuss it separately without any reference to conation is only possible in terms of verbal abstractions, not in terms of actual phenomena of life. In reality cognition and conation are inseparable. Without conation there would be no cognition and no ability. The value of both Speed and Power would be equal to zero. The criticism that a score on a test depends on conation, however true, is not relevant.

On (3), the arrangement was not made for the sake of pre-determining the factors, but for the sake of identifying them in case they appeared. We divided the battery into Speed and Power sections, but we also divided it into Verbal, Spatial and Numerical sections. This we regarded as the only satisfactory experimental arrangement in which the relative importance or the amount of correlational variance of Speed and Power, on the one hand, and of Verbal, Spatial and Numerical factors, on the other, could be compared. Further, if Speed and Power were synonymous, they should not have given rise to two distinct factors but only to one general factor. People who were better on Speed tests should have been also better on Power tests. This, however, was not the case.

On (4), the sample used in our research was selective because it was limited to a highly intellectual group. Had we been concerned with the standardisation of results and the determination of the actual Speed and Power factor loadings, it would have been necessary to employ a representative sample of the whole population. Our concern, however, was with a test of particular hypotheses. In testing our hypotheses the task mainly consisted in comparing the relative independent variance due to Speed and Power as against the independent variance due to Verbal, Spatial and Numerical dimensions.

Our interest lies in determining to what extent the variance of each variable shrank, as the result of the selection of the sample. If it shrank more in the direction of Verbal, Spatial and Numerical than in the direction of Speed and Power, then the hypotheses were verified only for the particular sample and should be verified again for other sections of the population, or for the whole population. If it shrank to the same extent, then the relative variance represented by the two alternative criteria of classification was the same in the sample, as it would be in the whole population.

Let us consider what was the actual nature of selection in our sample. It may be truly said that the difference between the sample used and the cross section of the population lay in the fact that all the members of our sample had passed a certain scholastic examination and, in addition, most of them had qualified on ordinary speeded tests of intelligence. The emphasis in the selectiveness of our sample was undoubtedly on the general ability as measured by Speed which, in fact, had been employed in ordinary intelligence tests and as measured by Power which to a great extent had been required in scholastic examinations.

On the other hand, there was no indication that the members of our sample were in any way selected, apart from the general ability, on Verbal, Spatial or Numerical proficiency. It was then reasonable to suppose that with respect to the latter dimensions, no other but haphazard selection had taken place. It was then unreasonable to believe that the variance of these characteristics had shrunk to the same extent as the variance of the variables on which a deliberate selection of the upper end of the distribution had been made. There was a remote possibility that this had happened, but the odds were rather overwhelmingly high against such a proposition.

Since the selection of the sample was such that the variability on Speed and Power was reduced to a much greater extent than that on Verbal, Spatial and Numerical dimensions, we can conclude that the variance of Speed and Power was much more underestimated in the sample than the variance of Verbal, Spatial and Numerical factors. Consequently the correlational variance due to Speed and Power can also be assumed to be relatively more underestimated.

The nature of the sample was then such that it favoured the appearance of Verbal, Spatial and Numerical factors rather than the appearance of Speed and Power factors. If nevertheless, in the conditions which were definitely unfavourable for the verification of the hypothesis in the sense that they were more suitable for the verification of the alternative view, our hypothesis was verified, confidence in this fact must be at least as strong, if not stronger, than in the case of its verification in a representative sample of the whole population.

THE "TRIAD" THEORY OF ABILITY

The nature of conation is alike in all living organisms, so also is the nature of cognition the same for all living organisms. There are, of course, differences in degree of development. In lower animals only a very slight proportion of conative energy is converted for cognitive purposes; in human beings the proportion is much greater.

The total quantity of mental energy which is created depends on the situation and on the capacity of the organism. The capacity depends on the two factors: the size and the resistance of the conductive paths designed to convert conative energy for cognitive purposes. When the size of these paths is small and the resistance is high, the capacity is low; when, on the other hand, these paths are complex and the resistance is low, the capacity is high.

With respect to a particular simple situation, when the amount of energy necessary to cope with the situation is small, the main difference between various organisms lies in the degree of resistance. (Low resistance is achieved by frequent repetition.) The latter determines the rate of conversion, or Speed. Since the situation is only a particular situation, not all the relay-paths of the organism are involved to the same extent. Certain particular paths are of special importance. This involves a specific ability.

Following the same reasoning, it can be said that the Speed dimension of one specific ability may be different from the Speed of another ability. It may be presumed that the environmental influences whether affecting the individual or the stock have been more suitable for the practice of one than the other. Consequently different individuals vary with respect to the Speed dimensions of various specific abilities. While some individuals have more facility for one ability, other individuals have more facility for a different ability.

Since the Speed dimensions of various abilities have played an important part in survival, it may be presumed that, in addition to particular facilities in particular situations, a general facility for quick discharge of energy has also been established. This would indicate the existence of a general factor of Speed in various abilities. Consequently there ought to be a positive correlation between various facilities of expression through different media.

Since the Speed dimensions of various specific abilities are positively correlated, there must be a central factor which causes these positive correlations. Either then, it must be supposed, that lowering the resistance in one path decreases the resistance in all other paths, or a 'central organ' must be assumed through which conative energy passes and where it is transformed into cognitive energy to be subsequently used in particular paths. The latter, we presume, to be the case.

In lower organisms with no differentiation in cognition this is undoubtedly so. In more advanced animals and in human beings, in addition to this 'central organ' the differentiation into particular functions has taken place. The Speed dimension of ability depends then on the resistance in the 'central organ' and in particular paths connected with particular adaptive actions.

The effectiveness of an adaptive response depends not only on Speed but also on the suitability of it for the purpose of achieving the goal. In certain simple particular instances of a familiar kind the response is naturally appropriate, but in complex, rather new situations, such an appropriate response is sought in a series of trial activities. In these cases the ability to transfer already possessed knowledge to the new situation is undoubtedly of paramount importance. (The word transfer is used here to denote the implicit or explicit use of already experienced relations to educe identical or similar relations from the situation.) This depends on the complexity and size of the organs connected with the conversion of conative energy into cognitive energy.

In certain particular instances when a specific ability is involved, the suitability of the response depends on the complexity of paths connected with this type of response. The complexity of these paths determines the richness of the relations at the organism's disposal. According to the richness of these relations, a new relation is discovered in an explicit or implicit manner. Since, however, *the nature of relation as such does not depend on the particular relata,* the complexity of paths connected with a particular medium of expression is as important for this medium as for any other medium. The Power dimension of ability depends therefore on the total size and complexity of paths and the 'central organ' through which conative energy is converted.

Unlike the Speed dimension, Power, because it is completely, or almost completely, independent of the medium of expression, has no specific values for specific abilities. It is entirely dependent on the central, general factor.

To recapitulate, we can say that ability is the total impetus of cognitive energy discharged in a particular situation. In nature it is alike in all living organisms. Quantitatively, however, it differs in different organisms with respect to the two dimensions, Speed and Power. Power is the total amount of energy which is determined by the size and complexity of the 'central organ' and the particular paths connected with it. Speed is the speed of transformation in the 'central organ' and the speed of conduction in specific paths. Since the resistance in different paths may be different, the speed dimension, in addition to having the general quantity determined by the resistance in the 'central organ', has also specific quantities in specific abilities.

Ability then, in its quantitative aspects, can be represented by the general factor of Power, the general factor of Speed and the specific factors of Speed.

These three components of ability, Speed, Power and Specific Ability, although fused in a particular action, can be separated from each other by means of a suitable experimental design and statistical analysis.

SUMMARY

The possibility of representing the general ability by two dimensions was demonstrated. These two dimensions were named Speed and Power of the general ability.

In addition it was proved that the factors of Speed and Power were more fundamental than the factors representing specific abilities like Verbal. Numerical and Spatial.

The theoretical basis for the existence of Speed and Power was tentatively formulated under the name of the 'triad' theory of ability. This theory assumed that ability in its quantitative aspects could be represented by the general factor of Power, the general factor of Speed and the specific factors of Speed.

REFERENCE

SPEARMAN, C. E. (1927): *The Abilities of Man.* London, Macmillan.

APPENDIX

The three most difficult items used in the Power section are presented below:

A VERBAL POWER TEST ITEM:

Mrs. Blake invited Mrs. Brown to tea. During tea they discussed the weather, but when they were about to leave the table, Mrs. Blake asked politely:

"Would you have a cigar, Mrs. Brown?"

"No, thank you", replied Mrs. Brown, "I seldom smoke them".

"I don't smoke them regularly either, only when I am particularly pleased with something. I think that today I ought to have one".

While Mrs. Brown was waiting for further explanations, Mrs. Blake concentrated on the cigar. After a few moments, however, she deeply inhaled, and having covered Mrs. Brown's face with smoke, said with pride:

"My youngest son is going to be married tomorrow".

"You have eight sons, I believe?"

"Yes", replied Mrs. Blake. "Here they are in alphabetical order: ADAM, BERNARD, CHARLES, DAVID, EDWARD, GEORGE, HENRY and PHILLIP".

"Which one is going to be married?"

"I will tell you his name, but not directly. You must infer it from what I am going to say about our family".

"ADAM and BERNARD, as you know, live in England. One of my sons who lives in London is a doctor. All doctors in our family married last year. Several years ago BERNARD and CHARLES were in the same boarding school. CHARLES played football in the school team, BERNARD belonged to the chess club. The secretary of the chess club, Frank Reed, had a younger sister, Rosemary, who was born at exactly the same time as the school football captain, Jack Lawton. Frank Reed was the youngest and ablest chess player in the school, Jack Lawton was the most experienced and oldest of all school football players. Miss Rosemary Reed became my daughter-in-law two years ago. She and her husband live now in a cottage twenty miles from London; they became farmers. EDWARD and PHILLIP, who are engineers, now live in America. DAVID is a regular Army officer. None of my sons who are farmers have ever played football in their lives.

"Half of my sons live in England. HENRY is the only one who stays with me here in Edinburgh. ADAM has the same occupation as GEORGE. BERNARD follows the career of his father. Although my husband did not belong to the medical profession, I am glad that two of his sons became doctors.

"Jack Lawton, whom I mentioned before as a newly-promoted officer, got his first assignment with my late husband who was then a colonel commandant. Lawton had two sisters, Brenda and Jean. My eldest son, EDWARD, fell in love with Brenda, but since she cared only for military men, he, heart-broken, left this country and went to America. She nevertheless became my daughter-in-law; so did her sister, who lives now on the farm with one of my sons. Brenda's husband never played chess in his life".

Mrs. Blake stopped and looked at Mrs. Brown's perturbed face.

"Well?" she asked.

"I think I will have a cigar now", replied Mrs. Brown.

"Help yourself, Mrs. Brown, but which of my sons is going to be married tomorrow?"

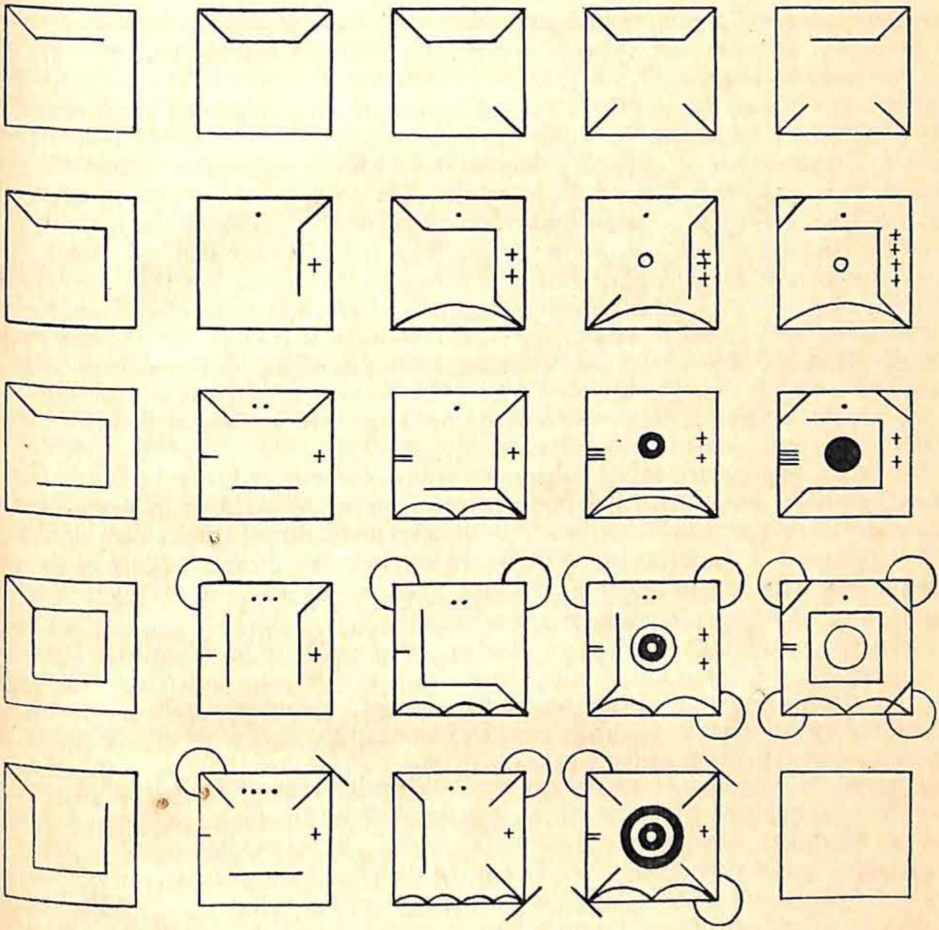
"That is simple, ..., of course", replied Mrs. Brown.

"You are quite right", said Mrs. Blake, passing the light to her friend.

Complete the sentence spoken by Mrs. Brown by writing down the name she mentioned in her reply.

A SPATIAL POWER TEST ITEM:

Draw an appropriate drawing in the blank square.



A NUMERICAL POWER TEST ITEM:

Write an appropriate number in the blank square.

1	2	3	4	5
2	10	24	46	78
3	21	58	124	231
4	37	112	260	524
5	62	199	491	

Book Reviews

The Later Working Life in the Building Industry: A Study of 320 Ageing Maintenance Workers. By F. LE GROS CLARK. London: The Nuffield Foundation, 1954. Pp. 21. Available on request.

This is the first of the studies of "social factors affecting continued employment of elderly workers" which Mr Le Gros Clark is making for the Nuffield Foundation. Examining the records of 15,000 building workers who in recent years quit their jobs with the London County Council, he found 320 men "whose careers were more or less traceable from the age of sixty onwards". He suggests that, although the majority left because of old age and sickness, some 17 per cent. retired earlier than they need have done; they recovered from their illness and returned to work, but they left shortly afterwards because "self-confidence and steadiness of gait and manipulation are not re-established". He summarizes by saying: "It is believed that in at least 17 per cent. of all cases measures of rehabilitation following an illness might have enabled a man to return for a longer period to his normal job." Unfortunately he gives us little evidence to support this admirable suggestion: we do not know whether any of these men had, or did not have, a course of rehabilitation.

The report is presented as "a 'laboratory' study of age in industry"; and it is not claimed that the sample used is representative of the whole building industry: as the author points out, maintenance work is usually more suitable for older men, and "they continued at the job as late in life as the employer could contrive, even at the cost of some ingenuity and forbearance". Other research workers may find it difficult to use the data: for example, wastage is considered by age group and trade and we have to compare 100 painters aged 58-59, 100 'other craftsmen' aged 60-62, and 120 labourers aged 59-63. Mr Le Gros Clark says, "There seems no significant difference in the later sixties and early seventies among the various groups of workers studied", yet a chi-square test of the wastages in the three groups between the ages of 65 and 70 shows the differences are significant at the 2 per cent. level.

The author's intention is not always clear. When he writes, "Only by studying the complex of causes that affect the rate of wastage shall we be able to salvage a few men here or there for a longer period of useful work", he is tackling a social problem. When, on the next page, he states, "This is not the place for a discussion of the various causes that led to the final departure of these men from the industry. . . . What matters is that we should have some broad indication of the organic factors that decide when and how men cease to be effective workers", he seems to be anticipating a physiological answer.

Mr Le Gros Clark must be congratulated for attempting an important investigation. In this report he has, at the least, shown how difficult it is going to be to make adequate deductions from the data available at present.

I. S. WILLIAMS

Annual Review of Psychology, Volume 5, 1954. Edited by C. P. STONE. Stanford: Annual Reviews, Incorporated, 1954. Pp. ix + 448. Price $7.

The *1954 Annual Review* seems to have had, in Britain, the same mixed reception as its predecessors. Some people (especially students preparing for their finals) have regarded it as heaven-sent. Others (especially teachers of these same students) have regarded it as the work of the devil, or several devils. What everybody seems to agree about is that it is expensive, and that it is odd that it cannot be bought in bits. Who, it is asked, is likely to want, for keeps, both Egan's scholarly survey of the present state of our knowledge of hearing, and Wrenn's review of counselling methods? Some individuals will, of course, and so will many libraries; but surely the question has point. The reviewer's copy of the 1953 book has been stolen, but he would not dream of spending seven dollars on a new one, much as he would like to have copies of half a dozen of the papers in it.

In the new volume, of special interest to readers of this journal will be Alastair Heron's admirable chapter on industrial psychology. It is characteristically clear, comprehensive and balanced; and it is a real review, not a string of drab and rather meaningless abstracts. Perhaps it could have been improved by some re-structuring, for it has some rough corners (notably the section labelled, despairingly, 'miscellaneous topics'); but we must not complain much about this, for the chapter as a whole is first-rate. Comparable in quality is the chapter on educational psychology, by James Maxwell, of Moray House; but Maxwell's personal likes and dislikes stand out a little too obviously at times, and his writing lacks the detachment of Heron's. E. L. Kelly, on theory and techniques of assessment, is excellent. His broad sweep of the field, which sometimes throws up very thoughtful reflections on fundamental problems, makes his contribution one to which reference is likely to be frequent. Tolman and Postman write on learning; Crutchfield on social psychology and group processes; and Brogden on statistical theory and research design.

British psychologists who look through Professor R. W. Russell's bibliography, at the end of his chapter on comparative psychology, may be somewhat taken aback when they find him describing their 1953 annual meeting as an animal meeting. However, even after remembering what happened at it, they will probably decide that his reference has merely been misprinted. ALEC RODGER

Satisfactions in the White-Collar Job. By NANCY C. MORSE. Ann Arbor : Survey Research Center, Institute for Social Research, University of Michigan, 1953. Pp. x + 236. Price $3.50.

This is the third in the series of reports from Michigan on the relationships found, in various industrial settings, between productivity, morale, and certain aspects of supervision. The two previous studies—*Productivity, Supervision and Morale in an Office Situation* (1950) and *Productivity, Supervision and Morale among Railroad Workers* (1951)—have already achieved something like classic status. [There is a fourth study—not published in book form—which antedates the one under review. It is by Donald C. Pelz, and is summarised in a short article entitled 'Influence : A Key to Effective Leadership in the First-Line Supervisor', *Personnel,* November, 1952. This study merits equal recognition with its two predecessors.]

The present book reports findings, obtained by interview methods, about the satisfactions of some 740 clerical workers in an anonymous American 'large-scale organisation'. Their 73 first and second-line supervisors are also studied in detail.

Dr Morse sets out from a theoretical analysis of the rôles of the worker and decides that there are four areas relating to a job which deserve to be considered separately : (i) the intrinsic interests and satisfactions of the work done, (ii) the satisfaction the worker finds in the human contacts with his colleagues, (iii) satisfaction with the Company as an employer, and (iv) satisfaction with the social status afforded by the job and by its financial reward. An interview schedule was produced to cover all these areas in some detail. Each area was allocated from 5 to 8 questions, which were expected on *a priori* grounds to give adequate and reliable samples of respondents' feelings. It was anticipated that questions would tend to 'scale' in the Guttman sense. In the event the intercorrelations were considerably lower than had been anticipated : average r's for each area were .32, .18, .33 and .37. This meant that the questions originally allocated to each area did not in fact form unidimensional scales. Dr Morse solves this difficulty by discarding eight of the original twenty-four questions, leaving four questions to form a scale for each of the four areas. By this means the average intercorrelations of questions allocated to the same scale rise to .50, .39, .45 and .52. These values are accepted as indications of adequate unidimensionality. The resulting four scales are then inter-correlated to see that they are reasonably independent of each other; one scale shows zero order correlations with the remaining three, the others intercorrelate .43, .35 and .39. Despite these relatively high correlations all the four scales are thereafter treated as if they were independent.

To this reviewer this seems to be a serious methodological flaw. In the first place Dr Morse discards one-third of the information which has been collected, in order to achieve scales approximating to her *a priori* categorisation, and although the resulting scales are not independent they are treated thereafter as if they were. It seems from the data given that there is a general factor of 'being generally satisfied' which accounts for much more of the variance than any of the group factors do. The failure to factorise the whole matrix, and to take out the general factor before hunting for the causes of variations in *a priori* group factors, makes the whole analysis difficult to follow and somewhat unconvincing. It may well be responsible, too, for the difficulty of arriving at any very broadly based explanations of the causes of high morale.

It is notable that the title of this book does not include the word 'productivity' and although some data on the relationships between morale, productivity, and supervision are given, this information is of little value because there are no details about the measures of production used, nor about the extent of the difference between the 'high' and 'low' productivity groups. It will be remembered that in the earlier report on office workers the productivity differences between the 'high' and 'low' groups were established from direct measures of output, and although they were maintained over a long period, they did not exceed 10% of standard output. In the railroad study, on the other hand, quantitative measures of output were not available and the research workers had to rely on ratings of productive efficiency by management personnel; this meant that it was impossible to say anything about the extent of differences between the output of the 'highs' and the 'lows'. In the present instance the data on productivity is confined to four matched pairs of work groups—*i.e.*, 118 workers in groups paired for background characteristics and type of work, 56 of them being under 'general supervision' and 62 of them under 'close supervision' (the 'generality' or 'closeness' of supervision being a measure of the personality and attitudes of the supervisors rather than a consequence of the kind of work done by the groups). With this very small number of groups the previously reported association between 'general' supervision and high productivity is confirmed, but only to a very slight degree (χ^2 shows a probability greater than .5).

Despite the methodological shortcomings of the book, it contains a large amount of empirical data. There are about a hundred tables setting out relationships between the various types of information collected during the interviews. These tables provide much that is of interest, though without any striking novelty. For instance, one finds that people doing more complex work tend to be more satisfied than people doing simple routine work, though some people are quite happy with routine jobs. One discovers that supervisors underestimate the importance which their workers attach to having congenial companionship, but are otherwise very shrewd in their estimates of the things their subordinates like or dislike. One finds confirmation of Dr Pelz's work showing that the amount of influence a supervisor has with his boss has a crucial effect on the way his subordinates regard his activities. The tables are, however, sometimes irritatingly incomplete. Men and women are usually lumped together, sometimes in cases where one might reasonably expect differences to appear; the demographic characteristics of the population show that 16% of the non-supervisory population and 59% of the supervisors were men, but thereafter one cannot find out the ages, seniority, length of service, etc., of the men and women separately. Tables are given showing the relationship between age and satisfaction, and between length of service and satisfaction, but the table showing the relationship between age and length of service is omitted, and the surprising statement is made, "There are not sufficient cases to test the independent effect of length of service with age held constant . . .", *N* in the tables being over 600. [For what it is worth, this reviewer found partial correlations of +.03 ± .10 between satisfaction and length of service with age held constant, and of + .24 ± .09 between satisfaction and age with length of service held constant, in a recent study of 108 women workers in a London office.]

Apart from her initial premises, Dr Morse makes two excursions into theory building. The first, which is quite interesting, seems to boil down to something like this: "If you get what you want in life you will tend to be satisfied, but if you want more than you get you will not". Dr Morse produces some empirical evidence to support this hypothesis. The second excursion purports to be a theoretical analysis of something called 'motivation'. It is unfortunately the case that your reviewer did not understand this chapter. Whether his failure was due to the tortuous way in which it is written or to genuine logical errors in the arguments ('amounts of productivity' seems to be a category muddle, since you can't have an amount of a ratio), will have to be left to other readers to decide.

The book is a rather disappointing successor to the previous reports. While it contains a great deal of empirical material which is of interest to those professionally concerned with the measurement of morale, the statistical treatment appears insufficiently drastic and unjustifiably ramified, and the literary style is of a complexity that will deter all but the professional psychologist—who, alas, has become inured to this sort of thing!

JOHN D. HANDYSIDE

Symposium on Fatigue. W. F. FLOYD and A. T. WELFORD (Editors). London: H. K. Lewis, 1953. Pp. viii + 196. Price 21*s*.

The subject of 'fatigue' has interested scientists for a long time—scientists claiming allegiance to several different disciplines, particularly physiology, biochemistry, neurology, and psychology. This interest was stimulated by operational problems relating to 'fatigue' arising during the last war and has continued to develop in the post-war years. The war research sought for answers not only to questions of the basic nature of 'fatigue', but also to questions regarding the control of 'fatigue' and the invention of biochemical and behavioural aids to this end. The fact that the majority of contributors to the present *Symposium on Fatigue* are associated directly or indirectly with organizations conducting research on problems in their particular specialities arising in industry and the military services indicates the importance with which the practical problems of 'fatigue' are viewed today.

Several reviews of theory and research in 'fatigue' have appeared during the past fifteen years. A number of the matters arising in these earlier reviews also appear in the present volume, which contains new information, some new points of view, and, happily for the reader interested in research, a number of problems in need of further attention.

Superficially, it might appear that the disciplines involved in the study of 'fatigue' have relatively few areas of overlap. However, the present symposium indicates that they can and do get together on this topic of mutual concern, and presumably, although it is not always certain, understand each other's point of view. Their individual interests become apparent when usages of the term 'fatigue' are examined. The definition of this term is a matter of real contention, as one already published review of the present volume indicates. Bartley and Chute in their 1947 text on the subject noted that "... A tendency not to define fatigue, but rather to state that certain symptoms arise from it, represent it, or are due to it, is characteristic. There are said to be three classes of pertinent phenomena: the work done, the physiological effects, and the conscious experiences". Among these classes are to be found dependent variables within the range of interests of all the disciplines concerned and the present symposium samples many of them.

Most of the contributors have seen fit to begin their discussions with a brief description of the ways in which they intend to use the term 'fatigue'. The major tendency is to use it as an intervening variable or theoretical construct defined in terms of certain essential conditions on the one hand and certain physiological behavioural and/or subjective experimental changes on the other. Sir Frederic Bartlett describes the essential conditions as "... the continuing exercise of (an) activity under its normal operational conditions". The consequents of this continuing exercise "... lead, either immediately or after delay, to deterioration in the expression of (the) activity . . .". This way of using the term 'fatigue' is not followed by all contributors. For instance, Professor Ryan centres his discussion on what he has called the "concept of effort". 'Effort' here refers to ". . . the experience of the individual as he works". It is employed as an independent variable and a search is made for physiological changes which correlate with it. Such a point of view may be thought of as lying between the position first described above and that emphasized by Bartley and Chute in stating that ". . . the subjective constituents of this fatigue pattern are not to be taken as epiphenomena, or as symptoms of fatigue, but as fatigue itself". These differing usages of the term 'fatigue' should not be troublesome to the reader of the present symposium as long as it is clear which is being employed in any particular context. The research worker in this field will concern himself with the precise operations by which the essential conditions are manipulated and the consequent dependent variables are measured. Since the present symposium is concerned primarily with research methods and the results of their application, it would seem desirable to evaluate the various contributions from this point of view.

As the editors have remarked in their preface, it is difficult to separate the papers into those of a distinctive physiological or psychological nature, since continuous work is associated with physiological, behavioural and subjective experimental changes. Which of these classes of dependent variables a particular chapter emphasizes is a matter of the contributor's choice and in many instances he has chosen more than one. The chapters concerned primarily with physiological variables present evidence that changes may occur as a result of a failure of muscle fibres to develop tension, of a failure of fibres to be excited by afferent nerve impulses, or by impairment of conduction in nerve fibres, across synapses or in the muscle end plate. Various measures of muscle action have been taken, including tremor and muscle potentials. Other more general measures of metabolism, such as oxygen intake and oxygen debt, have been applied to valuations of various work tasks in industrial situations and to attempts to discover means of postponing the onset of fatigue. These latter methods are not in themselves new, having already produced important results for A. V. Hill, J. S. Haldane and others. The present contributions are in terms of the new fields to which the methods have been applied.

The close relations between physiological and psychological changes resulting from continuous work are well illustrated in reports on "visual fatigue". For example, one chapter states that sub-optimal lighting conditions affect seeing ". . . because they necessitate undue muscular exertion in getting the required information, but also because they necessitate undue mental 'exertion' for the processes of interpretation and discrimination". Some very knotty problems arise in attempting to disentangle the complex interactions between physiological and psychological factors, particularly when studying the effects of environmental conditions on fatigue. Research on the influences of thermal conditions faces the difficulty of distinguishing between direct effects of temperature changes and indirect effects, such as differences in 'motivation', which appear to play such an important part in 'tropical fatigue'. Methods of separating such factors are suggested, for instance, in Dr Schwab's chapter on "Motivation in Measurements of Fatigue". Using a technique referred to as 'electronic ergography', some control over level of motivation has been achieved by driving a muscle directly with an electric current similar to the normal motor nerve stimuli to the muscle producing the work, thus studying fatigue of the muscle without involving the subject's voluntary control. These important relations between 'drives' and work decrements are recognised to be of basic importance in research on fatigue and are discussed by several contributors.

In considering the primarily behavioural correlates of continued work, Sir Frederic Bartlett has emphasized three primary criteria of deterioration. The earliest, and most delicate, is an ". . . increasing irregularity in the interval timing lay-out of the successive items of the performance which must be repeated". The second is "a splitting up or disintegration of the field of display . . ." and the third, a ". . . progressive widening of the field from which selection is made and consequent loss of direction". The application of these criteria is illustrated in a research report on "short-term fatigue" in which ". . . the deterioration of performance was almost entirely localized in the reaction time component of the skill . . ." and in another report on continued work over longer periods of time where deterioration of performance appeared to result primarily from systematic changes in "the perceptual mechanism". One contribution of particular interest to psychologists concerns itself with the learning and retention of motor skills, discussing certain basic training problems in terms of current research results and learning theory.

The present symposium is not intended to cover the subject of fatigue completely. It is not primarily a review of the present status of the field and it is not systematic in its approach. It has the major virtues of many such symposia: it brings together research workers from different countries; it presents the results of recent research; it contains descriptions of new methodologies and techniques that will be useful to researchers generally; and, it is particularly fruitful in suggesting a number of research problems which can profitably be attacked. Lest the 'practical' reader feel discouraged with the large number of questions still to be answered, the symposium suggests that our present knowledge makes it possible to improve methods of work, to design machines to reduce effort required and to reduce the amount of disability attributable to faulty use of processes involved in work.

R. W. RUSSELL

Design for Production. Anglo-American Productivity Report. London: British Productivity Council, 1953. Pp. x + 68. Price 3*s.* 6*d.*

Production Control. Anglo-American Productivity Report. London: British Productivity Council, 1953. Pp. x + 130. Price 5*s.*

One might have expected these two reports by AAPC specialist teams to be largely complementary. In a way they are, and yet they are astonishingly different. The terms of reference of the Production Control Team were "to investigate production methods and procedure from finality of the design stage to despatch". The Design for Production Team set out to study "how design can be integrated with production to ensure the best utilisation of available materials and standard parts. To examine the methods adopted for securing effective co-operation between research, design, development and engineering departments through purchasing and production to sales department".

Thus in their terms of reference the teams have set their themes. The Production Control report takes one on an arid safari in a jungle of forms. One catches an occasional glimpse of the natives—progress chasers with walkie-talkies, expediters on motor scooters, and other servants of the *Ens Entium,* Central Control.

The Design for Production Team describe a different culture. Here there are people with hearts as well as slide rules, with enthusiasms, loyalties, ambitions, gripes, with—in short, temperaments as well as talents. Well over half this report is devoted to such 'human factor' matters as recruitment, training, formal and informal communication in the management structure, promotion, amenities and trade unionism. It makes fascinating reading. It should be said that the report is probably just as descriptive of United Kingdom practice as it is of American.

The Production Control report is, by contrast, heavy going. While no one can doubt the value of properly organised control systems, this survey, by citing so much detailed evidence of methods employed by various American firms, does raise doubts whether good production control cannot be achieved without such a plethora of paper-work.

JOHN D. HANDYSIDE

Management Under Nationalisation. London: Acton Society Trust, 1954. Pp. 79. Price 7*s.* 6*d.*

This report, prepared by T. E. Chester and J. H. Smith, is based on field work carried out by Chester during 1949-52. It is that rare thing nowadays—the half-way house between a scientific investigation and a narrative of interesting selected instances. It avoids the dullness and aridity of much sample-based research—the kind of thing which finishes in the half dozen blinding glimpses of the obvious, all to four decimal places; nor does it give the reader the impression that he dare not generalise from the particular cases described. And there is a complete absence of polemics.

The task undertaken was to examine the dilemma of trying to obtain the advantages of centralisation (co-ordination, being able to afford a high standard of specialisation) and yet retain the advantages that go with local autonomy. Four examples are taken, all of them of operational managers, men responsible for on-the-spot, day-to-day decisions. They are: the area general manager in the coal industry, the power station superintendent in the electricity industry, the district manager in the Road Haulage Executive, and the manager of a local undertaking under the Gas Board. Through the device of using a single, composite representative of each of these, the impact of nationalisation is conveyed in concrete terms.

The chief difficulties and problems are then high-lighted and discussed, and shown to differ little, in essence, from those of all large undertakings, public *and* private. I am particularly indebted to the authors for (i) their illuminating comments on the 'line-and-staff' system of organisation; (ii) the appraisal of the functions of the National Coal Board Division; and (iii) an account of the organisation of the Wales Gas Board. (How the other three operational managers must envy 'Mr Jones the Gas': instructions to him from the Gas Board begin . . . '1. Carry on to the best of your ability and do not wait to act until you are told unless a specific action is expressly forbidden'.)

The report ends with two warnings: the first is that it is dangerous to dismiss the difficulties as teething troubles; the second urges operational managers to consider whether the functions of management may have to change because of increasing specialisation, and whether the whole conception of responsibility in industry needs re-exploration.

Seven and six seems a lot for 79 pages. It is worth twice the money.

DENIS MCMAHON

An Introduction to the Theory and Application of Motion Study. By ANNE G. SHAW. Manchester and London: Harlequin Press. Revised Edition, 1953. Pp. x+37+8 plates. Price 6*s.*

Most readers of this Journal will be familiar with the author's former publication, *The Principles and Practice of Motion Study,* which has so deservedly received high praise from both psychologists and motion study practitioners. Her present book covers the same ground in much-condensed form, so that it cannot be expected to add anything new. It is, in fact, a revised version of a wartime issue by the Ministry of Aircraft Production, circulated in 1944 to stimulate awareness of the benefits which can be obtained from an enlightened application of motion study.

Attention is drawn in the opening section to the distinction between 'motion study' and 'time study'. These are complementary, rather than similar or opposing systems. As in her more comprehensive text, Miss Shaw restricts herself to the former, which is defined as "the recording, analysis, and critical examination of the methods and movements involved in the performance of any piece of work and the developing of easier and more productive methods". All the techniques commonly used in industry and elsewhere for the above purposes are mentioned, and described more or less briefly. Process charts of all kinds, micromotion study, and ways of recording the path of movement, are included, leading on to topics like the "characteristics of easy movement", "arranging the workplace", and "installing a new method". Several practical examples from industrial experience, and illustrations, are used to amplify the verbal descriptions.

The book is so aptly entitled an 'Introduction' that criticism of its obvious simplifications and omissions would probably be out of place. However, even an introduction to a subject about which there is much misconception should endeavour to portray more than a bare, uncritical account of technical procedures for which the scientific basis is in no way so unchallengeable as their practical success might suggest. As an aide-memoire for students undergoing training in practical motion study, the book has a valuable rôle. It is to be hoped that the more thoughtful of them will turn to the larger texts (including her own) which the author lists at the end. D. WALLIS

Introduction to Experimental Method. By J. C. TOWNSEND. London: McGraw-Hill, 1953. Pp. ix + 220. Price 32*s*.

This is a disappointing addition to the admirable McGraw-Hill series on psychology. The author's (or publisher's) idea was a very good one, for there is indeed a lack of books providing the student of psychology with sensible, realistic explanations of scientific methods of enquiry, experimental and non-experimental; but it may be doubted whether the idea has in fact produced anything very valuable here. The book seems to miss its targets, one after another, either by going off tangentially or by running short of energy when it is otherwise getting on quite nicely. It is difficult to escape the conclusion that, sometimes, Dr Townsend is not absolutely sure what he is talking about. But it may simply be that he has committed his good idea to paper before giving himself time to think about it properly. Certainly, this is suggested by the somewhat *jejune* character of the opening chapter on psychology and science, and of some later chapters on statistics. ALEC RODGER

Other Books Received

The following books have been received. Their inclusion in this list does not preclude their review later.

Sex and the Social Order. By GEORGENE H. SEWARD. London: Penguin Books, 1954. Pp. x + 276. Price 2*s*. 6*d*.

Group Dynamics: Research and Theory. Edited by DORWIN CARTWRIGHT and A. F. ZANDER. New York: Row, Peterson & Co. London: Tavistock Publications, 1954. Pp. xiv + 642. Price 35*s*.

Adjusting to a Competitive Economy—the Human Problem. American Management Association Manufacturing Series No. 214. New York: A.M.A., 1954. Pp. 48. Price $1.25.

Is Management a Profession? By L. URWICK. London: Urwick, Orr & Partners, 1954. Pp. 28.

Science and Industry—the Pattern of the Future? By SIR H. HARTLEY. The First Fawley Foundation Lecture. University of Southampton, 1954. Pp. 24. Price 2*s*. 6*d*.

Mental Health and Human Relations in Industry. Edited by T. M. LING. London: H. K. Lewis, 1954. Pp. xx + 266. Price 21*s*.

First Report of the Joint Committee on Human Relations in Industry, March, 1953, to March, 1954. Department of Scientific and Industrial Research and Medical Research Council. London: H.M.S.O., 1954. Pp. ix + 16. Price 1*s*.

The Prediction of Student-Teaching Success from Personality Inventories. By F. T. TYLER. Berkeley: University of California Press, 1954. Pp. vi + 233-313. Price $1.25.

The Regulation of Businessmen: Social Conditions of Government Economic Control. By ROBERT E. LANE. New Haven: Yale University Press (London: Geoffrey Cumberlege), 1954. Pp. xiv + 1[illegible]. Price $3.75 (30*s*.).

A Review of Productivity in the Diesel Locomotive Industry. London: British Productivity Council, 1954. Pp. 22. Price 2*s*.

Rehabilitation. Summer, 1954. London: British Council for Rehabilitation. Pp. 1-32. Price 2*s*. 6*d*.

Industrial Engineering: Report of a Visit to the U.S.A. in 1953 of a British Specialist Team. London: British Productivity Council, 1954. Pp. xii + 116. Price 5*s*.

Shift Work. By F. P. COOK. London: Institute of Personnel Management, 1954. Pp. 36. Price 4*s*.

Research Methods in the Behavioral Sciences. Edited by LEON FESTINGER and DANIEL KATZ. London: Staples Press, 1954. Pp. xii + 660. Price 50*s.*

A Review of Productivity in the Building Industry. BRITISH PRODUCTIVITY COUNCIL. London: British Productivity Council, 1954. Pp. 48. Price 2*s.* 3*d.*

The Durham Research Review. A new journal edited by F. V. SMITH. London: University of London Press. First issue, September, 1954. Pp. 1-62. Price 5*s.*

Human Relations in Action. By H. E. BULLIS and C. W. KELLY. New York: G. P. Putnam, 1954. Pp. x + 86. Price $1.50.

The Working Fitness of Older Men (Second Report on the Later Working Life in the Building Industry). By F. LE GROS CLARK. London: Nuffield Foundation, 1954. Pp. 40. A limited number available free on application.

Electrical Accidents and their Causes, 1952. MINISTRY OF LABOUR AND NATIONAL SERVICE. London: H.M.S.O., 1954. Pp. 70. Price 3*s.*

The British Productivity Council Progress Report, 1953-1954. London: B.P.C., 1954. Pp. 20. Price 1*s.*

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